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THE
ASIATIC SOCIETY OF BOMBAY
Town Hall, Bombay.

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...IFICATIONS, RATES,

Specifications

AND

NOTES ON WORK,

COMPILED FOR THE USE OF THE P. W. DEPARTMENT IN THE BOMBAY PRESIDENCY

BY

CAPTAIN E. L. MARRYAT,

ROYAL ENGINEERS.

...OMBAY ...OF T... ...ROMB... ...BRAN... ...OF T... ...RIAT...

THIRD EDITION.

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PREFACE.

The principal object of this Compilation is to lay down a good standard set of specifications for use in the Public Works Department in the Bombay Presidency for all ordinary works, and a series of rates for such specifications. It is not to be supposed that the latter are perfect or absolutely correct; but it is believed that a tolerable approximation has been arrived at, and though owing to local causes it will not always be possible to work exactly to these rates, yet they form a useful standard for checking the amount of labour and materials used on works of various descriptions, or, if nothing more, a basis on which an accurate standard Rate Book can hereafter be framed.

In addition to this, sketches of Masonry, Brickwork, Carpentry, &c., have been added for the use of Maistries and others by whom the Roorkee Treatise and other larger and practical books are unobtainable, and some practical notes on various subjects have been compiled so as to form a handy Note Book.

An Index has been given to this edition, and some useful tables of Roofing by Major Seton, R.E.; and of dimensions of Doors and Windows by W. Howard, Esq., C.E., have been added.

If the Officers of the Department will only fill in, on interleaved copies, remarks on any practical points which they may have met with in their experience, as well as any suggestions for the modification or improvement of the specifications and rates, or for the introduction of any other subjects which may be usefully treated of in a work of this class, and will also kindly reduce all weights and measurements to lbs. and feet, instead of candies, maunds, &c., it is hoped that in a year or two a revised edition will be issued.

The following are the principal sources from which the specifications have been framed and notes compiled:—Standard Specifications, Oudh, by Captain Peile, R.E.; for Rájputána, by Lieutenant-Colonel Forlong; for Bombay by Colonel Fuller, R.E.; Specifications of G. I. P. and B. B. and C. I. Railways; The Roorkee Treatise; The Chatham Course; Professional Papers on Indian Engineering; Engineers' Pocket Book; The Manufacture of Portland Cement, by H. Reid, C.S.

The Compiler must also acknowledge with thanks the valuable assistance which he has received from many members of the Department.

THIRD EDITION.

The second edition of this Compilation, which was published in 1877, has now been revised under the orders contained in Government Resolution No. 33 E–185, dated 6th February 1882.

The matter contained in this edition, both new and old, has been arranged somewhat differently to that of former editions. The whole Compilation has been sub-divided into twelve distinct sections, of which the first nine in number relate to different descriptions of work, as masonry, flooring, roofing, doors and windows, &c., &c. In each of these sections the specifications and rates follow each other instead of being separately massed together as in former editions, —an arrangement which, it is hoped, will facilitate reference.

The tenth section contains tables of scantlings of flooring timber, trusses, doors and windows, &c.; whilst the eleventh is devoted to notes on work.

The twelfth, or appendix, contains tables to facilitate the calculation of earth-work in cuttings and embankments, and of the areas of arch rings, segments, &c., in the masonry work of bridges and culverts.

The number of specifications and rates has been very largely increased. The most important addition in this respect is a set of standard specifications for use in the Irrigation Department which has been furnished by the Chief Engineer for Irrigation.

The specifications for rubble masonry have been carefully revised, and others added. Having been duly approved by Government they are now issued as standard specifications for this class of work. A large increase has also been made in the number of specifications and rates for roofing of different descriptions and of different spans.

The Compiler of this edition has to acknowledge with thanks the great assistance he has received in his present duty from J. H. E. Hart, Esq., M.I.C.E., Chief Engineer for Irrigation.

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ERRATA.

Page 7.—In Specification No. XVII, para. 2, *for* "at last 10′ wide", *read* "at least 10′ wide".

Page 16.—In Specification No. XXIII, para. 1, omit the word "alternately" after the words "alternately to bond".

Page 29.—In top line *for* "raked and carefully", *read* "raked out carefully".

Pages 31 and 32.—*For* "entrados" *read* "intrados".

Page 89.—In Specification No. LXXIV, para. 3, *for* "ovals and fillet moulding" *read* "ovolo and fillet moulding".

Page 194.—In foot note *for* "compositor" *read* "compiler".

Page 244.—In foot note in last line *for* "breath" *read* "breadth".

Page 245.—Under size of door *for* "½′ × 7′" *read* "3½′ × 7′".

Page 256.—*For* column heading "The Beam Square" *read* "Tie Beam Square".

Page 309.—*For* "achitectural" *read* "architectural".

Page 310.—*For* "$\sqrt{2\,gh}$" *read* "w $\sqrt{2\,gh}$."

Page 327.—*For* "spandrel walls" *read* "spandril walls".

Page 333.—Prismoidal mean area corresponding to heights of 12 and 3 should be "228-0" and not "288-0".

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I.—GENERAL SPECIFICATIONS.

I.—Foundations.

1. Foundation trenches shall be taken out to the exact width of the lowest step of the footings; the sides will be left plumb where the nature of the soil admits of it, but they must be sloped down or shored up carefully when the soil appears treacherous and likely to fall in.

2. The filling in the foundations of any important work shall not be commenced without a written order from the Officer in charge of the work. The foundation of smaller buildings may be commenced on the authority, in writing, of an Assistant Engineer or subordinate.

3. All foundation pits must be taken down to firm hard soil, the quality and probable thickness of which should be ascertained before the foundations are passed.

4. When practicable, the foundations of a building will run at the same level throughout. If pit-holes occur they will either be dug out, or if too deep for this mode of treatment they will be strongly and firmly arched over. When the building stands on sidelong ground, the foundations will be properly stepped.

5. All spaces not filled up in foundation pits must be re-filled to the original surface of the ground with approved material well watered and rammed.

6. The price for excavation of foundations to include absolutely all incidental charges, such as shoring, pumping, baling, &c., and in wet founds the excavation shall be kept free of water while the masonry is in progress and till the Officer in charge of the work considers that the mortar is sufficiently set.

II.—Brick-making.

1. The bricks to be of such sizes as may be specified; if not otherwise specified to be $9'' \times 4\frac{1}{4}'' \times 2\frac{1}{2}''$, to be made of carefully selected clay approved by the Officer in charge of the work, and free from any admixture of blacksoil or moorum. All gravel, nodules of kunker, and roots of grass shall be removed by washing or otherwise. The clay must be well tempered; when practicable, it should be dug up before the rains, and left to weather for a few months, but, otherwise, it must be well watered, and turned over for at least 48 hours before use.

Earth.

2. The clay must not be taken from localities where salt water is found, and any clay containing the slightest trace of salt will be rejected.

Salt.

3. The bricks must be turned out with clean sharp edges, well and squarely shaped, hard burnt, and sound.

Shape.

4. The bricks must be thoroughly saturated with water where burnt, after which the sound bricks will be selected and brought on to the work, and passed for use.

Soaking.

III.—Stone.

1. For all work to be of the best description, from quarries approved by the Executive Engineer.

Quarry.

2. All stone to be sound, durable, free from flaws, cracks, veins, crystals, minerals, salts, or cavities, and of uniform colour and texture. No earthy discoloured, weather or water-worn stone shall on any account be used.

Quality.

3. Porebandar stone is to be of fine grain, good colour and free from salt. No Porebandar stone of doubtful quality, or of very coarse grain, or with black specks in it to be brought on the work, and if it has been at any time saturated with sea-water, it will be rejected.

Porebandar Stone.

4. All stones to be dressed to lie in the work on their natural quarry beds.

Quarry Beds.

IV.—Lime.

1. To be burnt from such lime-stone or kunker as the Officer in charge of the work may approve.

Lime-stone.

2. It shall be burnt on the site of the work (unless otherwise ordered) and in such kilns and with such fuel as the Executive Engineer or his agent may direct.

Site of kiln.

3. It shall be slaked in the presence of the Executive Engineer or his agents, before being put into the mill, and all impurities or pieces considered by them to be improperly or carelessly burnt shall be picked out, rejected, and removed at once.

Slaking.

4. The slaked lime shall be measured in measures approved by the Executive Engineer. The measures shall not be less than 4 cubic feet, or more than 10 cubic feet in content, nor in depth less than 1 foot or more than 3 feet. The measure shall be "stricken", and shall be fairly and honestly filled, so as to give, in the opinion of the Engineer, accurate measurement; but the lime shall not be unduly shaken or unfairly pressed down.

Measuring.

Fresh.

5. Lime shall invariably be used fresh and be carefully preserved from wet till required for use.

V.—Sand.

Clean.

1. To be clean hard, sharp, river sand, free from large pebbles, salt, shells, moorum, dirt, and other impurities.

Washing.

2. Unless otherwise specified, sand shall invariably be well washed and screened.

VI.—Soorkhee.

To be made from hard, well burnt, broken bricks. Soorkhee made from "peela" or underburnt bricks shall on no account be used.

VII.—Gravel for Concrete.

Shall be clean and of hard durable material, obtained from quarries approved by the Executive Engineer. The stones shall be of every size, from that of a hen's egg down to fine sand, mixed in suitable proportions; 25 per cent. of the material shall be so coarse that it shall not pass through a sieve having 4 meshes to the inch, the openings of the bars being $\frac{3}{16}$" in the clear.

VIII.—Mortar.

1. Shall be made of good fresh lime as in No. IV and clean sand as in No. V mixed in the ratio of 1 lime to $1\frac{1}{2}$ or 2 of sand or in such other proportions as the Executive Engineer may direct.

Mixing.

2. The materials shall be well and thoroughly mixed, and ground in an edge mill or ghanee for 5 hours, or for such a length of time as the Executive Engineer may direct, care being taken not to add more water than will bring the materials to the consistence of thick mud.

Used fresh.

3. Mortar shall be used as soon as possible after being mixed. It shall be kept damp in the shade or covered up till used, and if it has become set or hardened before being used, it shall be considered unfit for use and removed from the work, and no second mixing of it shall be allowed.

IX.—Pumice Mortar.

Shall be made as described for lime mortar, except that it shall have Aden pumice mixed with it in the proportion of 1 or $\frac{1}{2}$ part of ground pumice to 1 of lime, or such other proportion as the Executive Engineer may direct. The pumice shall be dried and ground in a flour mill so fine that it will pass through a screen of 50 B. W. G. about 2,000 meshes to the inch; it is then to be added to the lime and ground and mixed. Pumice mortar must be used within 48 hours after it leaves the mill.

X.—Cement Mortar.

1. Shall, unless otherwise specified, be made by carefully mixing 1 part of good fresh Portland Cement of approved quality with 1 part of good approved sand. Cement mortar shall be used within 3 hours after it leaves the mixing board or mill.

2. For concrete and rubble work the proportions of 1 part of Portland Cement to 4 of river sand, both by measure, and for the finishing coat in plastering floors, 1 of cement to 2 of sand have been largely used on the Karáchi Harbour Works with excellent results. The foregoing refer to the bulk of cement as received in India, which was generally about 10 per cent. in excess of the bulk as despatched from England. See No. LXXXVIII Roorkee Professional Papers, 2nd series.

XI.—Plaster.

1. Mortar for plaster shall be of fresh lime mixed with double the proportion of fine clean sand or in such other proportions as may be directed by the Executive Engineer, and shall be ground twice.

2. The grinding shall continue at least 5 hours each time, and an interval of 2 days shall occur between each grinding. Grinding.

3. After the second grinding more water to be added to render it plastic, and then hemp, &c., in such proportion as may be directed to be carefully mixed up with it. Masala.*

4. It may be kept for not more than 15 days before use, provided that during such time it be properly shaded and damped. Keeping.

XII.—Portland Cement.

Brand. 1. Shall be of a brand approved by the Executive Engineer.

Colour. 2. It shall be fresh, uncaked, of a light grey colour, and well ground.

3. It shall begin to set under water within 6 hours after being mixed with water, and shall continue to harden afterwards. It shall not crack or turn yellow while setting. Setting.

Tests. 4. It shall be subject to tests (Grant's) as follows :—

(*a*) It shall weigh at least 110 lbs. per striked imperial bushel or 86 lbs. to the cubic foot.

(*b*) It shall be ground sufficiently fine to pass through a 50 B. W. gauge sieve (or 2,000 meshes to the inch) with not over 10 per cent. residue.

---

* *Note.*—To 3 maunds of mortar add :—

Coarse sugar (gool)	1	seer.
Gum (gond)	1	,,
Hemp (thag)	½	,,
Catechu (kath)	¼	,,

(c) When mixed (neat) with water, and in 12 hours put under water, it shall on the 7th day after bear a tensile strain of 200 lbs. per square inch.

XIII.—Masonry and Brick-work in general.

1. The work shall be built plumb, curved, or battered, as may be required by the design, and carried out in a thorough workmanlike manner to the satisfaction of the Officer in charge of the work, and the contractor shall provide at his own expense, unless otherwise specified, all such moulds, templates, centres, scaffoldings, &c., as may be required for the proper execution of the work.

Scaffolding, &c.

2. For arches under 20′ span to be included in the price of arch work. Over 20′ separate charge to be made for centering.

Centering.

3. All stones or bricks to be thoroughly cleaned and wetted with fresh water before being put into the work. They shall be carefully set in mortar, which should be used stiff.

Wetting.

4. The work is to be kept wet while in progress till the lime is properly set. On Sundays and other holidays the top of all unfinished masonry is to be kept flooded, and labourers are to be employed for the purpose. Watering is to be done carefully so as not to wash the lime out of the joints.

Keeping wet.

5. Should the mortar perish, that is, become dry, white, or powdery, through neglect of watering, the work will be pulled down and rebuilt at the contractor's expense, or, should the contractor fail to water the work to the satisfaction of the Officer in charge of the work, the latter may supply the requisite men to water the work properly, and charge the cost to the contractor.

Failure to keep wet.

6. Where practicable, the whole of the masonry in any structure will be carried up at one uniform level throughout, but where breaks are unavoidable, the join will be made in good long steps, so as to prevent cracks arising between the new and old work. All junctions of walls to be formed at the time the walls are being built, and cross walls to be carefully bonded into the main walls.

Works to be carried up evenly.

When new work is added to existing structures, the old work must be prepared to receive the new, and both shall be carefully bonded together.

XIV.—Wood-work.

1. The whole of the timber used to be of the sort specified and of dimensions and forms shown in the drawings. To be in every case of the best description, full grown, sound, free from large and loose knots,

Quality of timber.

twists, shakes, sun cracks, flaws, or other defects, and all of heart wood, well seasoned, entirely free from sap wood.

Scarfs and joints, &c.

2. All mortice and mitre joints, tenons, scarfs, &c., shall be made and fitted accurately in a workmanlike manner in accordance with the working drawings, and to the satisfaction of the officer in charge of the work, and put together with red lead and oil.

Shrinkage.

3. If, after the wood-work shall have been erected, any undue shrinkage or bad workmanship shows itself, the contractor shall forthwith amend the same.

Rate.

4. The rate for framed wood-work to include all sawing, planing, jointing, framing, labor, and materials, for raising and fixing, and workmanship, also the fitting, fixing, and supply of all straps, bolts, nails, trenails, spikes, screws, &c., necessary for the framing and fixing.

Tarring.

5. All timber resting on, or bedded in masonry to be well tarred with boiling coal tar.

Air space.

6. The ends of the timbers set in masonry shall have a space left on either side so as to give the air free circulation round it.

Wood near fire-places.

7. No wood-work of any sort shall be set within 2′ of a fireplace or flue.

XV.—Cast Iron Work.

Quality.

1. To be of good, soft, grey, cold blast, or other approved iron. The castings to be sound, sharp, and clear, free from air-holes, flaws, and defects, and of the exact pattern drawn or ordered.

Moulds.

2. All moulds and patterns to be provided at the cost of the contractor.

XVI.—Wrought Iron.

In straps, bolts, &c.

1. To be of "Best" English iron of the sizes and shapes ordered. The iron-work to be free from "burnings," blisters and cracks. Welds to be sound and workmanlike.

Rivets.

2. Rivet holes shall always be drilled when made by hand, and shall only be punched when proper machinery is available. All rivets shall be firmly clinched whilst hot, and left with a neat clean head, free from cracks and flaws. All rivets not passed by the Executive Engineer shall be cut out and replaced at the cost of the contractor.

Bolts.

3. To have well-shaped heads, which shall be filed down if necessary so as to sit firmly and closely upon the washers, and these latter shall have a level bearing on the surfaces against which they butt. When they rest upon a curved surface, the washers will be bent to the same curve and accurately fitted.

4. All screws shall be cut with taps and dies, clean and true, with a full deep thread without any taper. The holes in the nuts to be tapped to the proper size, so that they may fit the bolt accurately.

Screws.

5. To be drilled where necessary, and to be concentric with the holes.

Countersinks.

6. All straps or collars to be shrunk on, so as to make them firm and tight.

Shrinking on.

7. All screws, bolts, straps and small articles of wrought iron are, while at a low red heat, to be dipped in or covered with raw linseed oil. When fixed, to receive two coats of good paint of the description and colour ordered. This work to be included in the rate.

Linseed Oil.

8. To be of "Best" "Best" iron of the section and strength ordered, with proper joints, covers, and stiffners. To be capable of bearing at least 5 times the load intended to be placed on them; to be properly rivetted up with Scotch Lowmoor iron rivets of the proper pitch.

Girders.

9. The girders to be cambered, so that, when loaded with the working load, they shall not fall below the horizontal.

Camber.

10. Shall be of the full length of the girders, unless otherwise specified.

Angle iron.

11. All girder work, after being properly cleaned, to be painted, unless otherwise ordered, with one coat of red lead, and when fixed with two coats of the paint of colour and description ordered, to be included in the rate.

Paint.

ROAD WORK.

XVII.—Earth-work.

1. Before any of the earth-work is commenced, the contractor is to clear the ground of all trees, jungle, and roots of all descriptions on the seat of the banks, cuttings, and other works. No separate rate will be allowed or paid for clearing the ground.

Clear the ground.

2. The embankments will be made from side cuttings in trenches on either side of the line of road. The top of the slope of the side cuttings shall never be nearer the toe of the bank than 10′, and they shall not be continuous but shall be broken at intervals of not more than 300′ by masses of earth at last 10′ wide at top. The sides shall be sloped at the natural slope of the soil. All embankments shall be raised in layers of 1′ in height, which must be carried out to the full width of the slopes in all instances, so that no additions may be required to the slopes after the bank is up to formation level.

Banks.

3. All large clods will be broken up, so as to allow of a regular subsidence throughout, and an allowance will be made for settlement of at least $1\frac{1}{2}''$ for every foot in height, or as much more as the soil may require, and no allowance or extra payment will be allowed on this account; the total quantities of earth-work calculated accordingly or shown in the section only will be paid for.

Subsidence.

4. Earth-work shall be measured from sections of bank to be raised, hollow to be filled up, canal or tank to be cut. The portion between cross sections to be calculated by the prismoidal formula.

Measurement.

5. The work in all cases to include breaking clods, levelling surface, trimming slopes, and maintenance of slopes, surface, &c., until after the close of the monsoon; *i.e.*, work accepted as complete, up to the 1st August, must be maintained to the following 1st November, but work accepted as complete after the 1st August in any year, must be maintained to 1st November in the following year. The surface of the banks to be kept in such form as will prevent the formation of pools of water in them, and ensure them being kept as dry as possible. Gullies formed during rain, either on the tops or slopes of banks, shall be cleared out in the ensuing dry season, and carefully filled in with fresh material, well rammed or trodden in.

Maintenance of Earth-work.

6. The material from cuttings will generally be disposed of in the embankments or deposited in spoil banks, in such positions as the Executive Engineer may direct; the toe of a spoil bank is to be at least 10′ from the top of the side slope of the cutting. Descriptions of the character of the soil in the cuttings, as ascertained by trial holes or borings, are generally shown on the section; but the contractor must bear the contingency of all variations in the character of the soil in the cuttings at his own cost. As a rule, cuttings will be paid for in full, according to the section; but when a portion of the material excavated, is used in the formation of an embankment, the work will be paid for as cutting, but not again as embankment.

Cuttings.

7. The side slopes of banks and cuttings, except rock and moorum slopes, will be sown with grass seeds or turfed, when the bank is well consolidated, or has stood at least one monsoon.

Grassing slopes.

XVIII.—Metalling.

1. The stone will be broken into cubes which must pass every way through a ring $1\frac{1}{2}''$ diameter. The pieces shall be square and sharp; no rounded pebbles or angular chips will be admitted. The stone shall be the hardest of its respective kind, and shall be approved by the Executive Engineer.

Size.

2. Metal will be stacked in long continuous heaps of such size, as shall be determined by the Executive Engineer, on the berm or side slopes, but on no account on the road itself. To cover settlement and wastage an allowance of 1″ per foot will be made in the height, 13″ being invariably measured as 12″. No metal shall be stacked until it has been thoroughly freed from earth and all other impurities.

Stacking.

Moorum.

3. Moorum shall be good, hard and clean, approved by the Officer in charge of the work.

4. The surface of the road will be picked up carefully before the new metal is put down, and all clods broken small, and all soft stuff thrown aside. The new metal will then be carefully spread over it. The surface being laid to a regular curve, with a rise of 2″ for 16′ width and proportional rise for others. To ensure correctness, wooden templates, the exact size and shape of the new coat, will be laid on the old surface at regular distances apart, and the metal will be laid to them without lumps or hollows.

Repairs.

5. The new metal will then be consolidated by rolling, being thoroughly saturated with water if the rain falling proves insufficient, and will be continued until the surface is thoroughly hard and smooth: no more "blinding" of sand and moorum being used than is absolutely necessary to ensure the metal binding. The weight of the rollers should be at least ¾ of a ton per foot of length.

Consolidation.

XIX.—Maintenance of Metalled Roads.

1. The surface of all roads to be kept smooth, level, and free from holes; whenever these appear, they shall at once be repaired, by cutting the metal for 1′ all round, carefully for 3″ in depth. This hole will be filled in with new metal and consolidated flush and even with the surface of the old, with heavy rammers. Earthen slopes will also be kept full and even, side drains free and open, trees trimmed and carefully tended, and all branches which interfere with the traffic, riders, &c., lopped off.

Keeping up surface, &c.

2. Pavings and foundations, masonry, iron, and wood-work of all bridges and culverts to be examined every year, as also the beds of streams for some distance above and below the road, with a view to any preservative works that may be required, to prevent scour or accumulation of silt, being promptly carried out.

Bridges, Drains, &c.

3. Where culverts are being repaired or rebuilt, only one-half shall be undertaken at one time, the other half being kept open for traffic, a clear 9′ in width at least being left.

Re-building culverts.

4. Diversions will be made where a bridge or culvert is unsafe, or where the width between parapets is too small to admit of being divided. The approaches should have a gradient of 1 in 20, and, unless the surface is hard and firm, a coat of moorum should be consolidated over the whole length of the diversion. All gaps, foundation pits, &c., shall be fenced in with stout railings, their positions being marked at night by lantern or fires under charge of a watchman.

Diversions.

II.—IRRIGATION BRANCH.

XX.—Large Reservoir Dams of Earth-work.

EARTHEN DAMS.—1. To consist (unless otherwise expressly specified) of an embankment with puddle and concrete trenches.

2. The section of the dam to be that used as a standard in the Department, or as shown in the drawings.

Section.

3. The embankment site to be first cleared to its full breadth of all trees, shrubs, grass, rubbish of all sorts, loose stones and soft stuff. The loose surface soil is then to be scraped off to a depth of at least 4 inches, and all roots to be dug out.

Preparation of the Site.

Where the line of the embankment crosses the feeder or river bed, the gravel and sand on the up stream side of the concrete or puddle trench is to be carefully removed down to some solid material.

The material of the bed on the down stream side of the trenches may, however, be left if it is firm and unlikely either to compress or shift in case of leakage from springs.

The material taken out as above directed and from the puddle and concrete trenches is to be carried clear of the dam site, unless otherwise directed by the Officer in charge of the work.

4. The embankment is to consist of a water-tight "hearting" of clay with a "casing" of mixed clay and moorum or gravel covering the slopes as a protection from the weather.

Construction.

5. The "hearting" to be the best and most retentive clay procurable within one-half a mile of the site, unless otherwise specified. No excavations to be made on the inside of the dam nearer the toe of the slope than twice the height of the dam opposite, nor on the outside of the dam nearer than 3 times the height of the dam. Nor is any excavation close to the dam to exceed 5 feet in depth.

Clay Hearting.

The clay must be free of salts, large stones, moorum and rubbish of every kind.

Note.—Pure stiff black soil is found to answer best for reservoir embankments.

6. The casing is to be of the above clay artificially mixed with equal parts of gravel or moorum; or it may be of any good natural clayey gravel procurable on the spot. All stones larger than a hen's egg to be rejected from the material used.

The "Casing".

When the mixture is made by hand, the materials are to be placed clear of the work, the dry moorum and clay are to be laid over each other in layers of not more than 6 inches deep, they are then to be mixed with a powrah by turning the stuff over and over; the mixture is then to be carried in baskets to the embankment, and again mixed and spread with powrahs in layers of the proper depth as specified hereafter.

7. The forming and consolidation of the embankment is to proceed as follows:—

Forming Embankment and Consolidation.

The site having been properly prepared and well watered as specified, the materials of both the hearting and casing are to be spread evenly in layers of between 4 and 5 inches, or such thickness as will roll down to about 3 inches when finished. The relative breadth of hearting and casing to be as shown in the standard section.

When the first layer is complete it is to be rolled, it is then to be thoroughly soaked with water, and the second layer of dry material spread, this is in turn to be rolled and wetted and a third dry layer spread and rolled and wetted, and so on till the dam is complete. In places where rollers cannot be worked or cannot reach, such as in edges and corners, the stuff is to be consolidated with heavy rammers (if possible made of iron).

8. Rollers may be of stone or iron, but of such a size and weight that they will give a pressure of between $\frac{3}{4}$ of a ton and 1 ton per foot in length of roller.

Rolling.

The rollers should be kept clean so as to prevent the material sticking to them.

9. When embankments cannot be properly rolled, the earth is to be spread in 3-inch layers and well wetted; when the surface has begun to dry so that it will not lift under the rammer, it is to be sprinkled with dry material, and the ramming is to be carried on by lines of work-people working forwards and backwards on the surface till the layer has been thoroughly consolidated. The rammer heads should, if possible, be of iron, and should weigh about 14lbs. Layer after layer is to be treated as above till the work is complete.

Ramming.

10. When new embankments are joined to old, the old work surface is to be removed to a slope and the junction to be dug up 2 feet deep, and both new and old stuff well watered and rammed.

Junctions of Earth-work.

PUDDLE TRENCH—1. A trench for the puddle is to be excavated with vertical sides along the centre line of the dam embankment.

Excavation.

2. The excavation is to be carried down till the solid rock or some other impervious material, such as "Mán Earth", approved by the Engineer, is met with. The excavation below the surface of the rock or "Mán" is to be carried on with slopes of 1 to 1 for two or three feet deep.

The sides of the trench to be carefully shored up when necessary; the lengths of trench opened out should not be more than can be quickly filled in.

Vertical steps, longitudinally in the trench, are to be avoided; level stages with steep inclines between being preferable.

Size of Trench.

3. The breadth of the puddle trench, when not otherwise specified, to be $\frac{1}{10}$ the height of the dam +3 feet.

The surface soil for 2 feet deep is to be removed on both sides of the trench for an equal breadth with the trench and refilled with selected clay well watered and consolidated as in the case of the rest of the embankment.

Springs.

4. All springs of consequence in the trench to be carefully plugged up or caulked before the puddle is laid.

The Puddle.

5. The trench, when ready, is to be filled in with good puddle made out of clean, tough, retentive clay. Soft, sludgy, peaty, sandy, salt, or puffy clays to be rejected.

Moorum is not to be mixed with or allowed into the puddle clay, and all stones larger than a hen's egg, and all grass or rubbish are to be carefully removed.

Gravel may be added to the puddle clay in proportions not exceeding 1 to 1 when the trench is wet, or in a less proportion if necessary on economical grounds and with the consent of the Engineer.

Laying the Puddle.

6. The clay generally may be put into the trench, in layers not exceeding 9 inches in depth, and there worked up with powrahs and men's feet and a little water into a stiff doughlike mud; but where the trench is deep, or there is little room to work, the puddle should be tempered upon the surface and thrown into the trench in balls, and there worked up as above. The layers of the puddle to be kept as level and uniform as possible. Puddle is never on any account to be allowed to dry. Should the surface of the puddle crack at any time, the cracked surface is to be dug up and the puddle re-made.

Ramming the puddle.

7. As the surface of the puddle layers dry up they should be consolidated with rammers.

When the puddle is finished it should be at once covered up in the work, or, when this is impossible, with wet earth or grass.

Concrete Trench.

8. At the crossing of the river or feeder, a concrete trench 5′ wide is to be excavated on the down stream side of the puddle trench and from 15 to 20 feet clear of it.

This trench is to be excavated down to the solid material of the bed, rock, "Mán" or clay, and as far into it as in the case of the puddle trench or as may be directed by the Engineer.

The trench is to be filled with concrete as in Specification No. XXII.

The concrete in the trench is to be carefully joined into the puddle of the puddle trench, as shown in the plan.

PITCHING.—1. The pitching is to be set on the water slope of the embankment from the level of 2 feet below the sill of the outlet sluices to 3 feet over the highest flood level, unless otherwise specified.

Stone.

2. The stone to be good, hard quarry or boulder stone such as will not weather on the surface. It is to be roughly squared with the hammer so as to ensure the stones fitting fairly one on the other so as not to expose the earth-work below.

Laying.

3. The stones are to be laid with their broadest faces downwards, firmly bedded in moorum, and packed up with chips of stone to form an uniform slope.

The use of chips to be confined to the bed on which the stones rest, and no pinning is to be allowed between the sides of the stones which are to be packed with the hammer or mallet close against each other, their general lie being approximately perpendicular to the slope of the face of the bank.

Size of Stone.

The depth of the pitching, unless otherwise specified, to be 6″ at bottom of slope, increasing uniformly by increments of 3 inches to 1′-9″ at highest flood level, and again decreasing in the same way to 9″ at top.

The depth of the pitching to be represented by one stone only.

Slope.

4. The face slope of the pitching when complete is to be that specified for the face of the dam, so that the varying depth of the stones must be allowed for in the earth-work and adjusted in the moorum bedding.

The surface of the work when complete shall be left clean of all refuse, and have a fairly neat appearance.

XXI.—Masonry Dams.

Details of Construction.

1. The masonry of dams is to consist of rubble stone of a durable nature, laid in mortar of hydraulic lime and clean sharp sand, and to be of the following classes, *viz.*—

(1) Front casing of hammer squared rubble masonry-facing backed with uncoursed rubble.

(2) Back casing of uncoursed rubble.

(3) Hearting of uncoursed rubble or concrete.

Face casing.

2. The casing in front (outer face of the dam) to average 3 feet in thickness, and to consist of a facing of hammer squared rubble laid at right angles to the face plane and a backing of coursed rubble masonry.

The facing to be as specified in No. XXXIII and to bond well with its coursed rubble backing, each stone of which is to be of full depth of the course, *i. e.* from 7″ to 10″, with parallel beds, but having side joints of any form.

Mode of laying.

3. The stones are to be fitted together as closely as is possible without much dressing.

The stones in alternate layers of the casing must break joint and bond in every direction: all stones to be well wetted before laying in mortar, and then driven down and into contact with the adjacent stones by a light mallet. The spaces between stones in the backing to be filled with mortar, and then wetted pinners or chips of stone to be inserted so as to save mortar and increase the weight of the masonry.

Finishing.

4. The face joints to be neatly struck with a trowel, but not pointed or raised. The back of the rubble of the casing is to be left rough, so that the stones may bond into the hearting of uncoursed rubble, or concrete, used to form the centre of the dam.

Back Casing and Hearting.

5. Uncoursed rubble (in the interior or hearting of the dam or back casing) to be as specified in No. XXIII, except that the surface of the work is not to be brought to an uniform level, but is to be bedded and driven home, stone upon stone, by a mallet.

6. The hearting is to be laid and bonded closely into the casing as soon after the latter is built as possible, and it will extend horizontally between the inner edgings of the casings.

Note.—Hill stone should weigh about 184 lbs. per cubic foot, and quarry stone the same; any trap rock weighing less than 175 lbs. should not be used in face work.

Uncoursed rubble is to be used as filling in all parts of the dam that may be subject to more than 60 lbs. of pressure on the square inch, and as the back, or water face casing, of the dam when concrete hearting is used.

MASONRY DAM

Sectional Elevations.

Fig. N^o I.

Casing of hammer squared rubble facing with rubble backing and concrete hearting.

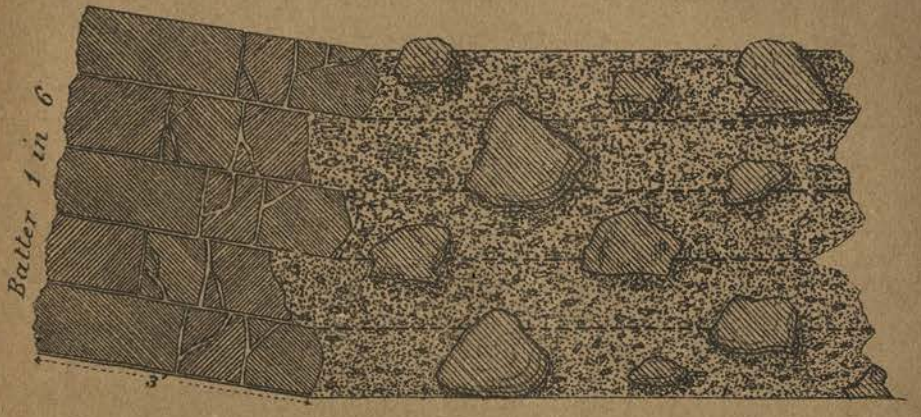
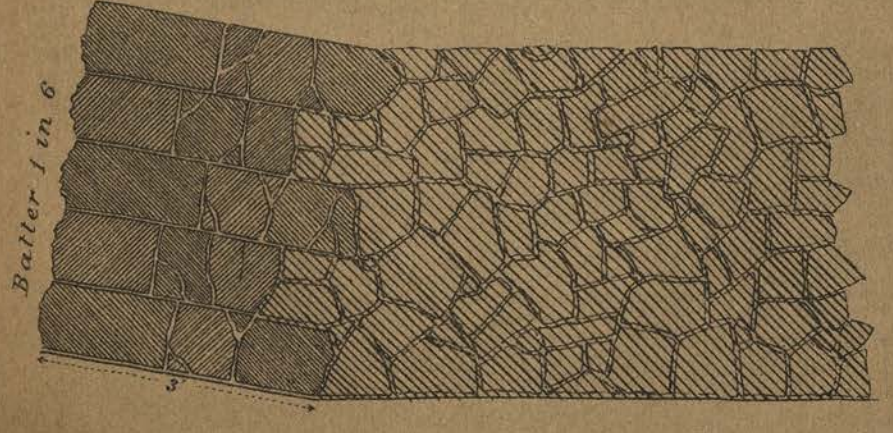


Fig. N^o II.

Casing of hammer squared rubble facing with rubble backing and uncoursed rubble hearting.



Govt Photozincographic Office, Poona, 1882

7. The foundation of the wall is to be excavated well into rock everywhere, (and at any place subject to an overfall, well into rock of the hardest description); then to be dressed to a slope, so that the foundation courses of the casing may have its upper surface at right angles to the face of the dam.

Foundations.

XXII.—Concrete in Dams.

1. This is to consist of broken stones, pebbles, and clean gravel or shingle intimately mixed with mortar of hydraulic lime after being well wetted.

Material.

The materials should be of all sizes up to what can be conveniently turned over and rammed.

The proportions should be chosen so that all interstices are filled up completely, and mortar just creams up on being rammed with light rammers.

2. The mortar will generally consist of two parts of sand to one of lime, and the usual proportion of the concrete (unless otherwise specified) will be—

Proportion.

Metal	2 parts	6 parts.
Shingle	2 „	
Pebbles	2 „	
Mortar	3 „	

3. These are to be turned over and over on a platform, or in a mixer, seven times at least. It is to be laid in courses equal to those of the face work on alternate days; the adjacent masonry being well wetted and the concrete carefully pushed in with pointed stakes so as to join it and the casing closely. If more than a day has passed since the masonry was built, mortar should be thinly plastered on its edges after they have been wetted, so that the concrete may take hold and unite to it firmly; this provision will seldom be necessary, as the hearting work should closely follow on the casing.

Preparation.

Note.—Concrete may be used for all parts of the interior of the dam where the greatest pressure cannot exceed 60 lbs. on the square inch.

4. Heavy stones and boulders too large for mixing with the concrete may be inserted in it as it is being laid. These will bind the layers of concrete together, economise mortar, and add to the weight. They should generally form one-third part of the whole. They should be well wetted before insertion and also when the concrete is being laid about them.

Boulders built in.

5. All masonry and concrete is to be carefully watered and kept damp from the moment that the mortar in it sets sufficiently to allow water to be sprinkled on it safely.

Watering.

MORTAR.—1. The mortar for masonry and concrete is to be prepared as follows; well-burnt hydraulic lime is to be placed in the ghanee in an even layer, and to be well sprinkled with water, but not drowned. After an hour it is to be wetted thoroughly: at the end of the two hours it is to be stirred, and any unslaked lumps removed, then covered with water, and allowed to stand two hours more; in all, four hours. It is then to be ground for 3 hours, water being added whenever it becomes stiff.

Preparation.

2. Clean, sharp, and wet sand is then to be added in such proportions as may be found by experiment to be best, usually 2 of sand to 1 of lime, or otherwise as directed by the Executive Engineer. The sand and lime to be then ground together for two hours,—total grinding 5 hours.

Proportion.

XXIII.—Masonry in Canal Drainage Works.

UNCOURSED RUBBLE.—1. The masonry used, to be of good, uncoursed, fitted rubble, consisting of sound building stone of at least three-quarters of a cubic foot in size for face work, laid full in mortar with parallel beds, or nearly so, all through the work. The side joints are to be close for at least 3 inches from the face, and no two adjacent stones are to be of the same length; chips may not be put under stones, but are to be used to fill up interstices in the side joints so as to save mortar.

Bond.

2. A bond of at least six inches to be maintained throughout.

Watering.

3. All stones to be well wetted before being laid, and all work to be kept wet until the next course is laid on it.

ARCHING.—1. The arching of aqueducts is to consist of stones with beds parallel (approximately) to the summering, and well bonded at the side joints and ends. No stone to extend less than half the thickness of the arching, and the stone behind it may project beyond the arch into the backing, except at and near the crown, where the work must be very carefully laid, and ends of stone cut off, if necessary, so as not to obstruct the waterway. The ring pens are to be dressed on their beds only, and are alternately to bond alternately well into the rubble sheeting and into the spandril walls. Near the crown they will meet the string course, and must be dressed roughly there for this to rest upon.

Construction.

Skew backs.

2. The skew backs are to be dressed only on their horizontal and skew beds. They are to bond back into the masonry of the abutments, cutwaters, and easewaters.

Caps of piers and pilasters are to be dressed on their beds, and 4″ in from the face at side joints, and chamfered at their edges.

The exposed surfaces are to be brought approximately to the forms shown in the drawings, scabbled or hammer dressed roughly. The stones of which cutwaters are formed, are to be bonded very carefully, not only one with another by breaking joint, but into the body of the work behind them.

CONCRETE.—The concrete to consist of broken stone, gravel, sand and hydraulic lime in the following proportions by measure :—

Metal	2 parts
Gravel (large)	1 part
Do. (small)	1 ,,
Sand	2 parts
Lime	1 part

The stones to be well wetted and then thoroughly mixed with the mortar, the lime having been previously slaked and ground with the sand for at least 7 hours. All concrete to be used fresh and to be well rammed in 9-inch layers.

POINTING.—1. Shall not be done except where expressly ordered by the Executive Engineer, but when so ordered it shall be as follows :—

Raking out and cleaning joints.

2. The joints of the masonry shall be raked out to a depth of at least $\frac{3}{4}$ of an inch, cleaned of dust, and left open for inspection, and this part of the work shall be approved of before the pointing begins.

When the filling in of the joints is in progress, the face of the work shall be well wetted and the joints kept damp.

Hollows.

3. The pointing shall be done with fresh finely ground mortar of the best description. The mortar shall be worked well back into the joints with the trowel, so that no hollows shall remain.

Note.—As a rule, pointing may be avoided if the joints be neatly struck or finished off by the masons as they build the work ; in any case the pointing should be done while the mortar of the work is fresh and "green".

The pointing shall be finished off neat and smooth, raised or otherwise, as may be directed.

No false joints shall be allowed.

To be kept damp and sheltered.

4. The work shall be screened from the sun and kept damp for 3 days, or till the mortar of the pointing has properly set and hardened.

If necessary for this purpose, screens of grass or matting should be put up.

Proportions of sand and lime.

5. When not otherwise specified, the mortar used in pointing should be made with half the proportion of sand specified or used in the mortar with which the rest of the masonry is built.

6. Pointing of the inside the parapets, flank walls, extrados of arches, tops of haunches of arches over piers and abutments and of aqueducts to be executed with Portland cement of approved description. The work shall be done as specified for above, only that the joints shall be raked out to a depth of full 1 inch, and the work finished off with special care, so that there shall be no leakage through the joints.

Pointing to be of cement in certain cases.

The Portland cement used shall be fresh, mixed with an equal bulk of clean fine (sifted if necessary) sand into a stiff mortar which shall be used before it has begun to show any signs of setting.

SLABS.—1. Slabs used for covering openings of superpassages to be full 6 inches in thickness throughout their entire length, and to have a bearing of at least 6 inches; the two outer slabs to have bearings of 8 inches.

Sizes.

2. These outer slabs forming the face to be neatly chisel-dressed, and all intermediate slabs to be roughly hammer dressed only.

Dressing.

3. The joints between the slabs to be carefully made up with chips and mortar, so as to make the work solid and close throughout.

Laying.

XXIV.—Canal Banks.

1. The canal embankments shall be of the general dimensions shown in the plans, and shall generally be made from material excavated from the cuttings: where this material is insufficient, it should be obtained from trenches excavated along the boundaries of land taken up for the canal.

Materials whence obtained.

2. The canal embankments shall be formed in 6-inch layers, each layer being thoroughly watered, and well rolled or rammed before the next is commenced.

Construction.

3. Spoil banks, that is banks made where the cutting is of a depth greater than the maximum depth of water in the canal, shall be neatly made of similar form and as far as possible of the dimensions as the canal banks, but may be made in layers 12 inches in thickness, and need not be watered and rammed.

Spoil.

4. A berm of 4 feet to be allowed between the toe of the canal bank or spoil banks; but where the canal is wholly in bank, these berms may be omitted.

Berm.

5. The side slopes of the canal in cutting to be as follows :—

Slope.

In soil ...	...	... 1½ to 1
,, soft moorum	...	... 1 to 1
,, hard ,,	...	... ¾ to 1
,, rock ...	...	... ¼ to 1 or vertical.

6. Bed stones and stones on the banks of the canal to be placed at every 1,000 feet, and to be properly and consecutively numbered; the bed stones to be accurately laid to the "formation" level at that point.

Bed stones.

7. Mile stones to be fixed at the end of each mile and quarter mile to be placed near the boundary hedge, and to have a bench mark cut on the top.

Mile stones.

PITCHING.—Pitching where necessary for the protection of the slopes shall consist of stones of a prescribed thickness laid on moorum, by hand, on their base or broader end, and each stone shall be well and firmly bedded in its place.

XXV.—Laying Cast Iron Pipes.

1. The trenches shall be excavated along the lines denoting pipe lines, as shown in drawings, and are generally to be excavated to such depths as will admit of a minimum cover, that is depth of filling above the top of pipes, of 2½ feet.

Excavation of Trench.

2. The various materials excavated to be separated and placed, so that in refilling they may be again relaid in the same order, and thus the least possible damage will be done to public roads, cultivators, fields, &c.

3. After laying the pipes, as hereinafter described, the earth shall be filled in and around the pipes, and shall be carefully beaten and trodden down, so as to effectually secure them in their proper place: the earth shall then be filled in to the height of one foot above the pipes, and shall be watered and rammed thoroughly, the succeeding layers to be six inches in thickness, each to be thoroughly rammed and consolidated before the next is put on.—The original surface of roads to be properly restored.

Covering in.

4. The pipes, before being laid, shall be brushed throughout, to remove any soil or stones that may have accumulated therein, the inside of the socket and outside of the spigot being carefully cleaned, and then shall be laid singly in the trench in a straight line, and bedded firmly on the solid earth.

Preparation of pipes.

Laying.

When the trench has to be excavated through rock, a layer of earth, about six inches in thickness, shall be placed between the bottom of the pipe and the rock. The pipes shall rest uniformly

and firmly upon this bed throughout their whole length, and all shall be properly driven home, and shall be jointed in the following manner :—

5. SOCKET PIPES—

1*st.* One complete lap (at least) of white hempen spun yarn shall be forced to the bottom of the socket.

2*nd.* As many laps of white or tarred hempen yarn shall be tightly driven so as to leave a space of 2½ inches clear for the lead.

3*rd.* The remaining space, which should be previously dried, to be filled, at one running, full of good new lead melted from the pig. The lead to be run flush to the outside of the joint, and must be at least 3 times "set up", that is, caulked or driven up with properly proportioned caulking tools and light sledge hammers of about 4 lbs. in weight, and it is specially directed that each joint maker shall employ a proper striker to assist him in caulking the joint instead of depending on his own blow. After being well and firmly set up, the lead fringe must be pared off, and the joint left neat and even with the socket of the pipe. Sufficient time must be allowed for the lead to cool before the joint is caulked.

6. TURNED AND BORED JOINTS—

1*st.* The planed edges to be painted with red lead.

2*nd.* The remaining space to be run with lead, and caulked, &c., as with socket pipes.

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Ashlar Fine.

Fig: I
Elevation.

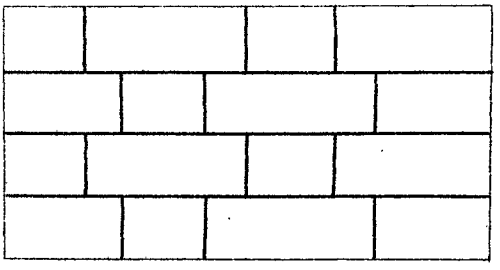


Fig. II
Section.

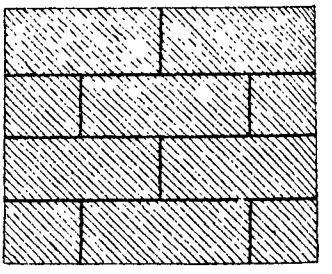


Fig. III.
Plan, 1st Course.

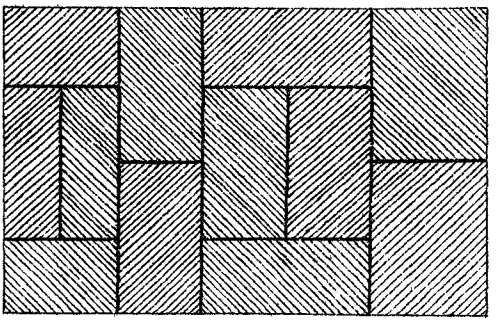
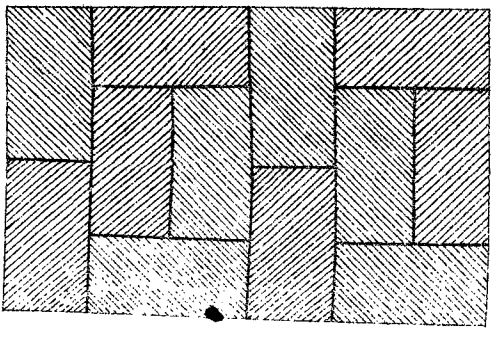


Fig. IV.
Plan, 2nd Course.



III.—MASONRY SPECIFICATIONS.

XXVI.—Ashlar—Fine.

Dressing.

1. Every stone shall be fine-tooled on all beds, joints, and faces, full, true and out of winding if the surfaces are plane, or to uniform curves or twists if required by the design.

Thickness of joints.

2. The stones shall be set in fine mortar (neeroo), the beds or joints being in no case more than $\frac{1}{8}''$ in thickness, and all visible edges shall be quite free from unsightly chippings. Each stone will be struck with a maul, when laid, to bring it to a solid bearing, both as to bed and joint.

Sizes of stones.

3. The stones shall be laid in regular courses not less than 12″ in height, and all courses shall be of the same height, unless otherwise specified, in which case no course shall be thicker than any course below it. No stone shall be less in breadth than in height, or less in length than twice its height.

Bond.

4. The face stones shall be laid header and stretcher alternately (unless otherwise ordered.) The headers being arranged to come as nearly as possible in the middle of the stretchers above and below, and the stones shall break joint * on the face, or at least half the height of the course, and the bond shall be carefully maintained throughout the wall.

5. Through stones.—In walls $2\frac{1}{2}'$ thick and under, the headers shall run right through the wall.

Courses.

6. The course lines shall be truly horizontal, and side joints vertical throughout.

N. B.—This class of work will probably only be required for beds for machinery.

XXVII.—Ashlar Rough-tooled, or Bastard Ashlar.

1. The faces exposed to view shall have a fine dressed chisel draft 1″ wide all round the edges, and be rough-tooled between the drafts, and on all beds and joints, which shall not exceed $\frac{1}{4}''$ in thickness.

2. The stones shall be set in ordinary mortar. In other respects with regard to size of stones, bond, &c., to be precisely the same as in Specification No. XXVI.

XXVIII.—Ashlar, Rock, Rustic or Quarry-faced.

1. Shall be in all respects similar to No. XXVII, except that the exposed faces of the stone between the drafts shall be left rough as the stone comes from the quarry; but no rock face or "bushing" to project more than 3″ from plane of drafts.

*Break of joint means the horizontal distance of the vertical joints of one course from the vertical joints in the courses above and below it; such as A, B, fig. 1.

The drafts may be omitted altogether, except at quoins, if preferred.

XXIX.—Ashlar—Chamfered.

Shall have the edges round the exposed face of each stone bevelled off to 45° for about a depth of 1″ (or more, as may be specified), in all other respects similar to No. XXVIII.

N. B.—Numbers XXVII, XXVIII, XXIX are suited for solid courses to run right through high piers or at the top of piers or abutments to carry large girders.

XXX.—Ashlar Facing.

1. The faces of stones shall be rough-tooled, rustic (with or without chisel draft, except at quoins), or chamfered, as specified for the particular work.

Size of stones.

2. In walls built of rubble or concrete and faced with ashlar, the ashlar stones shall be as specified in XXVII, except in the matter of dressing the backs of the stones, which may be left rough in the state they leave the quarry.

Dressing beds.

3. But the beds and joints shall be rough-tooled, true and square for at least the same distance in from the face as the thickness of the course in which they occur; *i. e.*, if 12″ courses are specified, the beds and joints shall be dressed 12″; if 15″ courses, beds, &c. shall be 15″.

Bond.

4. Bond stones shall run quite through the backing when work is no more than 2½ feet thick, or if more shall overlap at least 6″, and they shall be inserted between 5 and 6 feet apart clear in every course.

How paid for.

5. In work of this sort the face-work alone will be paid for as ashlar, and of those stones only so much as is dressed back, true and square on the beds and joints, ½ more being allowed for headers, (*i. e.*, in 12″ courses a thickness of 16″ from the face would be paid for as ashlar), the remainder to be paid for according to the character of the backing.

6. The height of the courses should equal an exact number of courses of brick or rubble with intermediate mortar joints, and the backing shall be carried up simultaneously with the face work.

Note.—This class of work is suitable for face of piers and abutments of very large bridges.

XXXI.—Block in Course.

Differs only from ashlar rough-tooled in the size of the stones. The height of the courses should not be less than 7″.

Note.—Suitable for through courses in piers, abutments of large bridges, or for top courses of same in girder bridges, for verandah pillars, or in large buildings as barracks.

Rock or Rustic Ashlar with Chisel draft

Fig: I.
Elevation

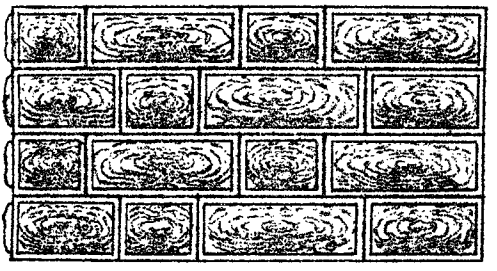
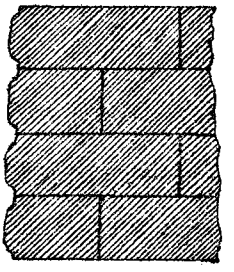


Fig: II.
Section



Chamfered Ashlar

Fig: III.
Elevation

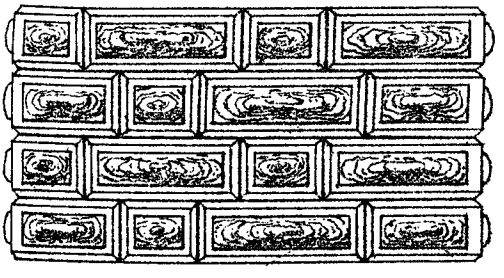
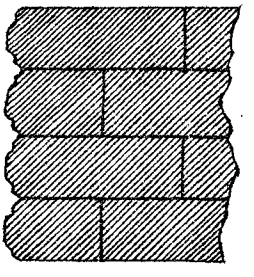
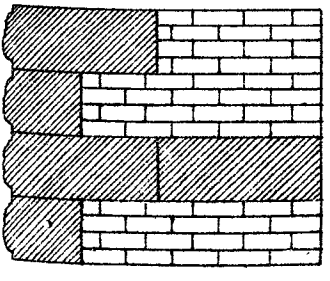


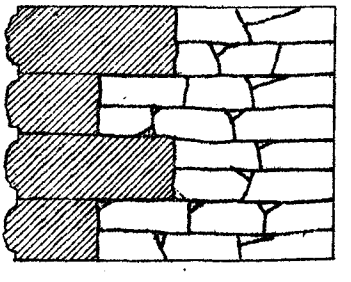
Fig: IV.
Section



Ashlar facing
to Brick-work
Fig: V.
Section



Ashlar facing
to coursed Rubble masonry.
Fig: VI.
Section



Govt: Photozincographic Office, Poona, 1882.

XXXII.—Block in Course Facing.

1. The height of the courses shall not be less than 7″, and all courses shall be of the same height, unless otherwise specified, in which case no course shall be thicker than any course beneath it. No stone shall be less in breadth than in height, or less in length than twice its height. All stones to be set full in mortar.

Size of stone.

2. Stones shall break joint at least ½ the height of the course.

Break of joint.

3. The face of the stones to be left rough (but no projection to exceed 2″) without chisel draft, except at quoins where ½″ draft shall be given.

Face.

4. The joints and beds of all stones to be truly vertical and horizontal, and all stones to be rough-tooled, true and square, for at least the same distance in from the face as the thickness of the course in which they occur; *i. e.* in 7″ course, at least 7″ beds, in 9″ course, 9″ beds, and are not to exceed ¼″ in thickness. The back of the stones may be left rough as they come from the quarry.

Joints and beds.

5. At least ⅓ of the stones shall be Headers tailing into the work at least twice their height, and "through" stones shall be inserted 5′ apart which shall run quite through the backing in walls 2½′ thick and under, or, if more, a line of headers shall be laid from face to back which shall overlap each other at least 6″.

Headers.

6. The course shall be equal in thickness to an exact number of courses of brick work or rubble, including intermediate joints; and the backing shall be carried up simultaneously with the face work.

7. Only so much of the face stones as is dressed back, full true, and square from face will be paid for as block in course, ⅓ being added for headers. The remainder to be paid for according to the character of the backing.

How paid for.

XXXIII.—Coursed Rubble, 1st Sort.

1. The stones shall be laid in horizontal courses not less than 7″ in height. All the stones in each course shall be of equal height, and all courses of the same height, unless otherwise specified, in which case no course shall be thicker than any course beneath it. All stones to be set full in mortar.

Height of courses.

2. The face stones to be hammer squared on all joints and beds. The beds to be hammer dressed, true and square, for at least 3″ back from the face,

Dressing.

and the joints for at least 1½". The face of the stones to be hammer dressed, and "bushing" not to project more than 1½".

Thickness of joints.

3. No pinnings will be allowed on the face. All side joints shall be vertical and beds horizontal, and no joint shall be more than ⅜" in thickness.

Size of stones.

4. No face stone shall be less in breadth than its height, or shall tail into the work to a length less than its height, and at least ⅓rd of the stones shall tail into the work at least twice their height, or in thick walls three times their height.

Through stones.

5. Through stones shall be inserted between 5 and 6 feet apart in the clear in every course, and shall run right through the wall when not more than 2′ thick. When the work is more than 2′ thick, a line of two or more headers or stones shall be laid from face to back, which shall overlap each other at least 6".

Break of joint.

6. Stones shall break joint at least half the height of the course.

Quoins.

7. The quoins, which shall be of the same height as the course in which they occur, shall be formed of header stones at least 1½′ long, laid lengthwise alternately along each face.

Interior face.

8. The work on the interior face shall be precisely the same as on the exterior face, unless the work is to be plastered, in which case the side joints need not be vertical.

Interior of wall.

9. The interior of the wall to consist of flat bedded stones carefully laid on their proper beds and solidly bedded in mortar, chips and spauls of stone being wedged in wherever necessary, so as to avoid thick beds or joints of mortar, care being taken that no dry work or hollow spaces shall be left any where in the masonry. The upper surface of the work shall be brought to an uniform level at the height of every course.

Note.—This class of work is suitable for the larger class of buildings, and for piers and abutments of ordinary bridges.

XXXIV.—Coursed Rubble, 2nd Sort.

Description of work.

1. This description of masonry shall consist of a facing of hammer squared stones on one side, with a backing of rubble masonry built in courses of the same height as the facing, and bonding properly with it. All stones to be carefully set full in mortar.

Face-work.

2. The face-work shall be as specified for coursed rubble, 1st sort (Specification No. XXXIII.) The stones in each course *need* not, however, all be of the same height, but not more than two to be used in the height of the course, and the joints may be as much as half

Coursed Rubble 1st Sort
Elevation Fig. I.

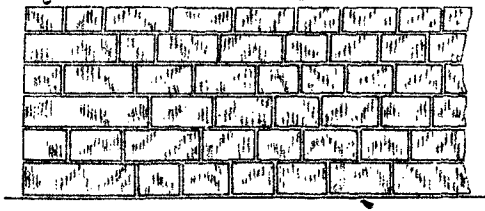


Fig. II.
Plan, Course 1.

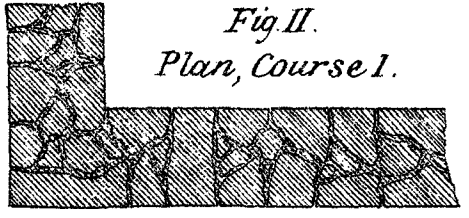
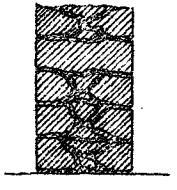


Fig. III.
Plan, Course 2.

Cross Section Fig. IV.



Coursed Rubble 2nd Sort
Elevation Fig. V.

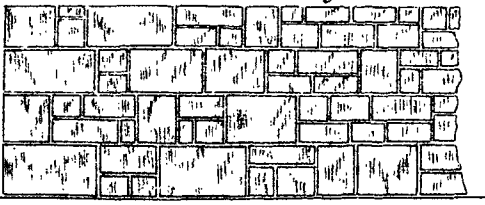


Fig VI
Plan, Course 1.

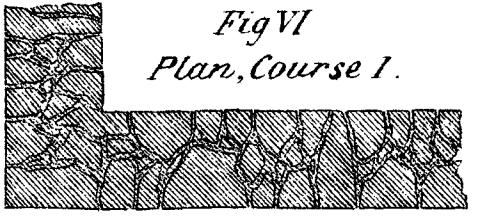
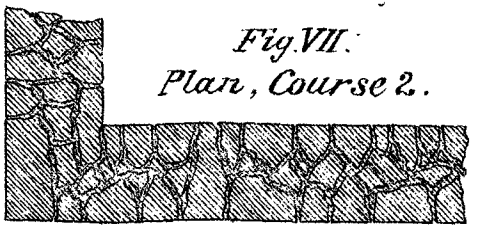
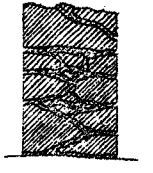


Fig. VII.
Plan, Course 2.



Cross Section Fig. VIII.



Coursed Rubble 3rd Sort
Elevation Fig. IX.

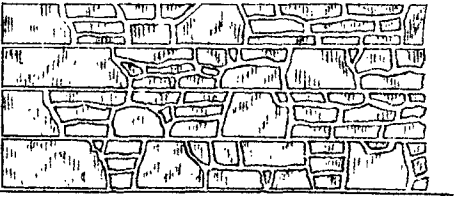


Fig X
Plan, Course 1.

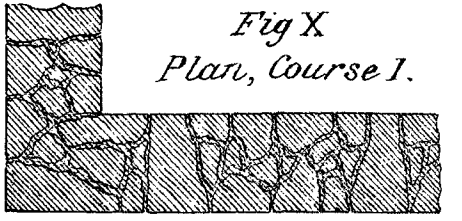


Fig XI
Plan Course 2.

Cross Section Fig. XII.

Photozincographed, Govt Office, Poona, 1882.

an inch in thickness. No course shall be of greater height than any of those below it.

3. The hearting or backing shall consist of uncoursed rubble masonry (Specification No. XXXVIII), which shall be carried up simultaneously with the facing, the face stones being backed as soon as laid, and each course as completed levelled off at top.

Hearting or Backing.

4. In all respects, other than those specified above, the facing and backing shall correspond with Specifications Nos. XXXIII and XXXVIII respectively.

XXXV.—Coursed Rubble, 3rd Sort.

1. In each course, Headers, hammer dressed, of the entire height of the course, are to be placed 5 feet apart, each header to be of a breadth not less than the height, and to tail into the work at least 3 times its height. Between the headers, each course is to be built of smaller stones not less than 2″ thick of which there may be two or three in the height of the course. These stones need not be dressed, but should be as flat bedded as possible; the side joints need not be vertical, but no side joint shall form an angle with a bed joint sharper than 60.° No stone shall be less in breadth or length than its height, and care must be taken to make the stones in the different courses break joint. All stones to be set full in mortar.

Description of work Headers and Joints.

2. In walls of two feet and under these headers to be through stones. In thicker walls a line of headers to be laid from face to back which shall overlap each other at least six inches. Care should be taken not to place the headers of successive courses above one another.

Through stones.

3. Quoins, &c., as in coursed rubble, 1st sort.

Note.—This class of work is fitted for all minor and subsidiary buildings when the height of the walls is not very great, for enclosure walls, culverts, wing walls, &c.

XXXVI.—Random Rubble, 1st Sort.

1. The face stones shall be laid absolutely without pinnings on the face. Every stone shall be carefully fitted so as to form neat and close joints, and, if necessary, the edges shall be dressed with a chisel so as to ensure close jointed work. Joints not to exceed ¼″ in thickness.

Fitting.

2. The stones shall be roughly chisel dressed and uniformly coloured and of pretty equal size on the face. They shall be carefully laid and solidly bedded in mortar, and shall tail back and bond well into the backing, and shall not be of greater height than either breadth or face, or length of tail into the work.

Size of stones.

3. One Header or Through stone shall be inserted in at least every square yard of the face, and shall run right through the wall if not more than 2′ thick; if more than 2′ thick, a line of these shall be laid from face to back which shall overlap each other at least 6″.

Through stones.

4. The stones shall be arranged to break joint as much as possible, and long vertical lines of jointing shall be carefully avoided in the facework.

Break of joint.

Quoins.

5. To be same as in Specification No. XXXVIII, para. 6.

XXXVII.—Random Rubble, 2nd Sort.

Same as above, but face and joints of stones to be only hammer dressed, and joints may be $\frac{1}{2}$" thick.

Note.—Random rubble is most suitable for spandrils of arches.

XXXVIII.—Uncoursed Rubble.

1. The stones to be set in the work as received from the quarry, and without further dressing of any sort than that of knocking off weak corners and edges with the mason's hammer.

Dressing.

2. The stones shall be carefully laid so as to break joint as much as possible, and solidly bedded with close joints. No joint shall exceed half an inch in thickness. Chips of stone and spauls shall be wedged into the work, wherever necessary, so as to avoid thick beds or joints of mortar. No dry work or hollow spaces shall be allowed in the masonry anywhere; every stone, whether large or small, shall be set flush in mortar, smaller stones used in the filling being carefully selected to fit roughly the interstices between the larger ones.

Bond and laying.

3. The face stones shall be laid, as far as possible, without pinnings in front, and they shall be selected from the mass of quarry stone for greater size, good beds, and uniform colour. They shall be laid, so that they shall tail back and bond well into the work, and shall not be of greater height than either their breadth on face, or length of tail in the work. Fifty per cent. of these stones shall be one cubic foot in content, and twenty-five per cent. shall be headers tailing into the work at least 15 inches.

Face stones.

4. One Header or Through stone shall be provided for every square yard of facing. They shall be at least half a square foot in area of face, and shall run back into the work at least two feet, or be the full depth of the work if it is less than two feet. If the wall be over two feet thick, a line of headers overlapping each other 6 inches shall be laid right through the wall.

Through stones.

5. A fair proportion of the stones used in the hearting shall be of a large size. Thirty per cent. of them shall exceed three quarters of a cubic foot in content.

Size of stones.

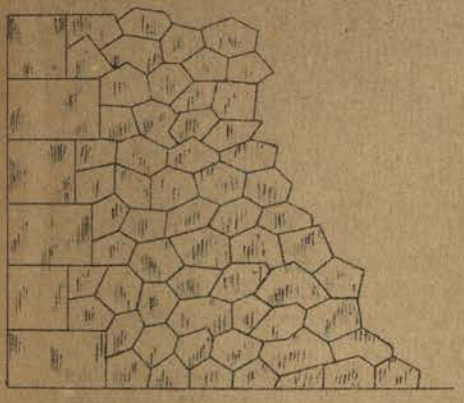
6. The quoins, unless otherwise specified, shall be of selected stone, neatly dressed with the hammer to form the required angle; and laid header and stretcher alternately. No quoin stone shall be less than one cubic foot in content.

Quoins.

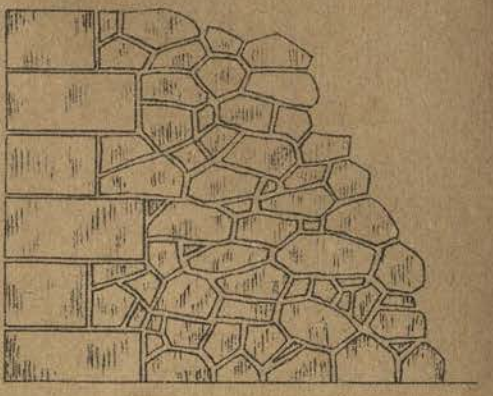
7. The exposed face of the work shall be carefully and neatly pointed with mortar in all joints, and round each stone, large and small. The

Pointing.

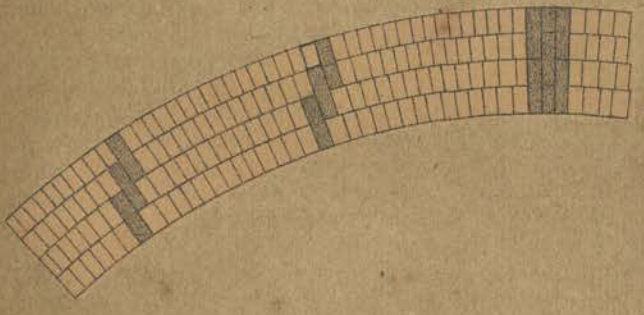
Elevation.
Random Rubble 1st Sort.



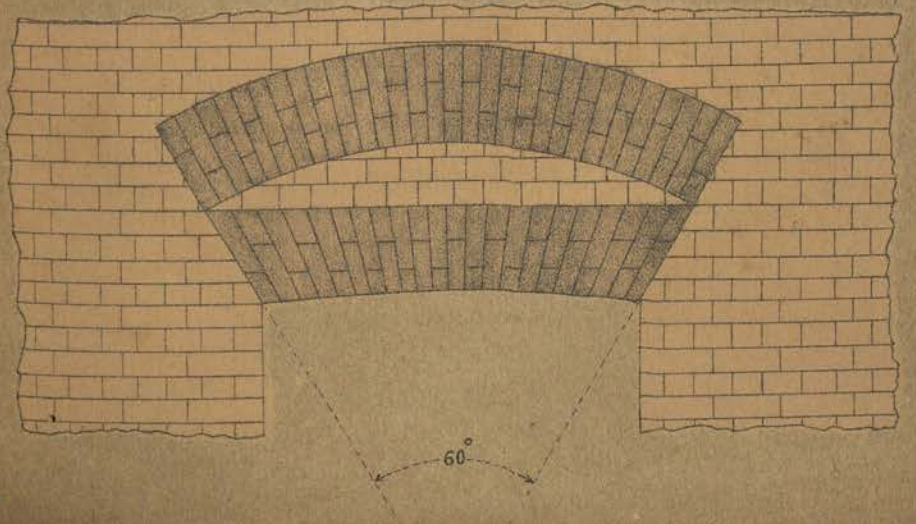
Elevation.
Random Rubble 2nd Sort.



Brick Arch



Flat and Relieving Arches.



Civil Photozincographic Office, Poona, 1882.

joints shall be raked and carefully at least one inch, and wetted and pointed with good fresh mortar carefully inserted, and the joints neatly finished off with the trowel. At the back of the work the joints shall be finished off by being neatly struck and smoothed off with the trowel while the mortar is fresh.

XXXIX.—Stone and Mud Masonry.

Description of work.

1. Shall be of the class and character of masonry designated above coursed rubble, 3rd sort (Specification No. XXXV), except that mud is used instead of mortar.

Mud mortar.

2. The mud used for this purpose shall be prepared from carefully selected earth of a tenacious nature, which, when dry, will form a kind of cement. The earth to be well tempered by men's feet, and worked down with water until it is perfectly free from lumps, and of the consistence of thick paste. Sand and chopped straw to be added in such proportions as the officer in charge of the work may direct.

Note.—When this description of masonry is used for supports of centerings, thin timber ties should be inserted at every three feet, to bind the faces of the wall together. This object is equally gained by building brushwood or split bamboos between the courses. At the ends of the walls the brushwood should be laid so as to cross the face layers.

XL.—Dry Stone Masonry.

1. Similar in all respects to coursed rubble 3rd sort (Specification No. XXXV), except that the stones shall be laid dry without mortar of any kind.

XLI.—Dry Rubble Retaining Walls.

Section of wall.

1. These walls to be built of dry rubble stone masonry in courses of from 8 to 20 inches in height, and when not exceeding 30 feet in height to have a section of at least 3 feet width at top, to be perpendicular at back, and to have a batter in front of 1 in 4.

Foundations.

2. The foundations if in moorum to be carried down to a depth of from 2 to 3 feet below the hill slope at the outer side, and to be filled in with the largest blocks of stone procurable within a moderate distance, carefully laid and packed in by hand with stones of a smaller size.

Superstructure.

3. The beds of the stones to be laid at right angles to the face batter. Each course to be built through the wall with proper bond in respect to itself and the course below. The front and rear faces of the wall to be built precisely similar in all respects, and to be equally bonded with the interior of the work.

Through stones.

4. Through stones or headers, at least 3 feet in length, to be provided in each course at intervals of from 5 to 6 feet apart on the face of the work, and continued throughout its whole width, each header overlapping the one in front by 9 inches so as to tie the front and rear

faces of the work together. These bond stones shall be of the full height of the headers in the facing, as broad at least as they are high, and of the greatest length readily procurable beyond 3 feet.

Stones.

5. The stones used to be of the largest and best description procurable within a moderate distance, and to be roughly hammer dressed so as to secure as large bedding surfaces as possible. When laid, all hollows round them to be tightly packed by hand and hammer with smaller stones.

Filling behind wall.

6. *The filling immediately behind the wall to consist, as far as possible, of stone refuse and chips. Earth not to be used for this purpose if it can be avoided.*

Note.—In masonry by "hammer dressed" is understood dressed with the "sootkie" or Deccan masons'hammer.

XLII.—Brick-work, 1st Class.

Size moulding.

1. The bricks to be of uniform size ($9'' \times 4\frac{1}{2}'' \times 2\frac{1}{2}''$, unless otherwise specified), thoroughly well burnt and sound, ringing clearly, and moulded on tables with sand, soorkhee, or water, as may be ordered by the Executive Engineer.

Bond.

2. The bricks are to be laid flush in mortar in such bond as the Executive Engineer may direct, and every course must be thoroughly grouted, and the whole executed in a good and workmanlike manner.

Colour.

3. As far as practicable, bricks of a uniform colour are to be selected for the face-work when it is not to be plastered.

Joints.

4. The bed-joints are not to exceed $\frac{3}{8}''$ in thickness, *i.e.* with bricks $2\frac{1}{2}''$ thick; 4 courses, including mortar joints, are not to exceed $11\frac{1}{2}''$ in high.

Soaking.

5. The bricks to be soaked for at least 12 hours before they are put into the work.

Bats.

6. No bats or half bricks to be used in the work, unless absolutely necessary as closers.

XLIII.—Brick-work, 2nd Class.

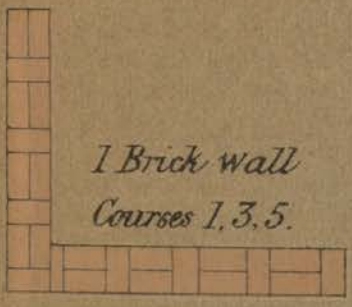
Same as above, but bricks may be moulded on the ground, joints to be not more than $\frac{1}{2}''$ thick (or 4 courses not to exceed 1′ in height if bricks are of English pattern.)

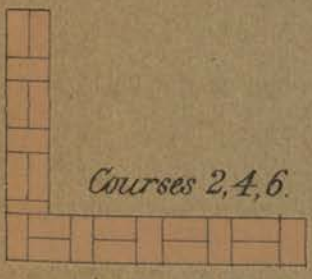
XLIV.—Brick and Mud Work.

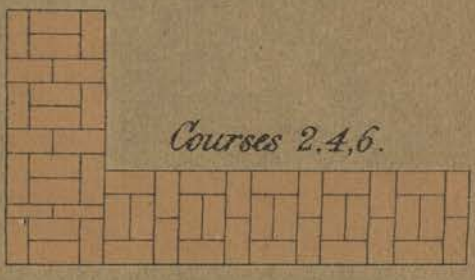
Bricks as in 2nd class, but laid in mud, made of earth, approved by the Executive Engineer, which is to be well tempered and worked down with water till it is perfectly free from lumps and of the consistency of stiff paste. To be mixed with chopped grass or sand, if necessary, in such proportions as may be directed.

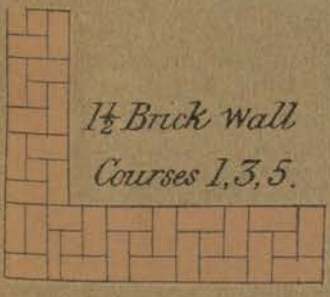
Flemish Bond

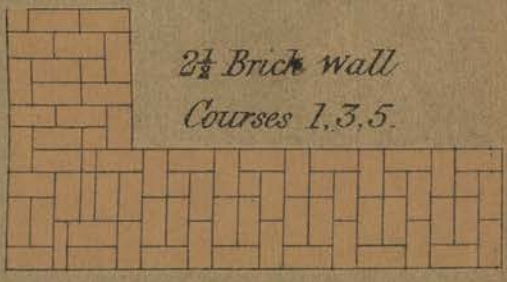
Plate VI

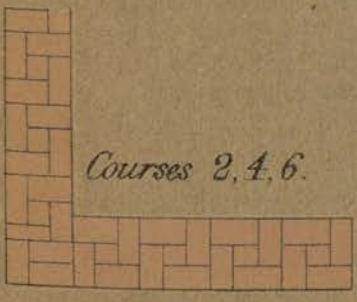


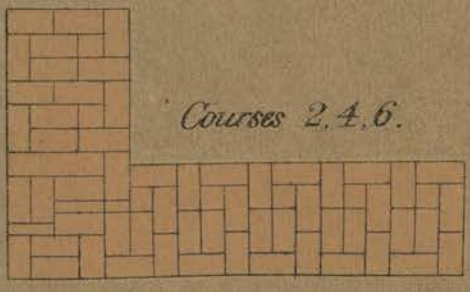




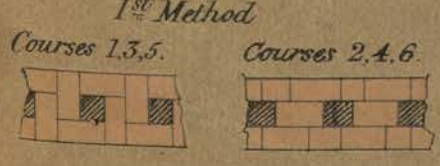








Hollow Walls
with common bricks



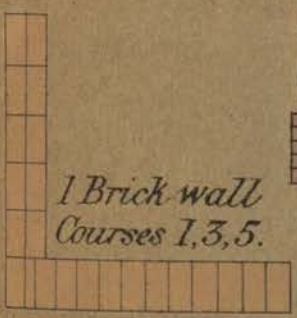
Govt. Photozincs Office, Poona, 1882.

Brick Work
English Bond

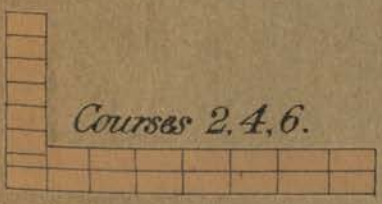
Plate VII

Section

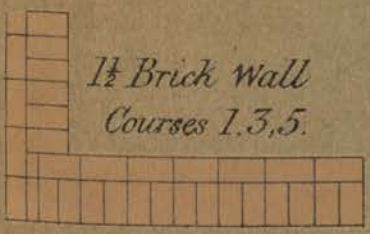
1 Brick wall
Courses 1,3,5.



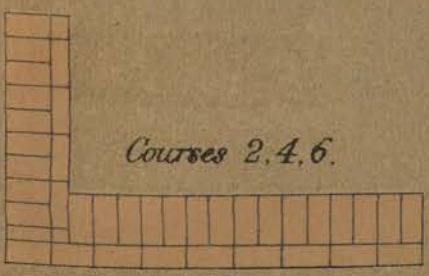
Courses 2,4,6.



1½ Brick Wall
Courses 1,3,5.



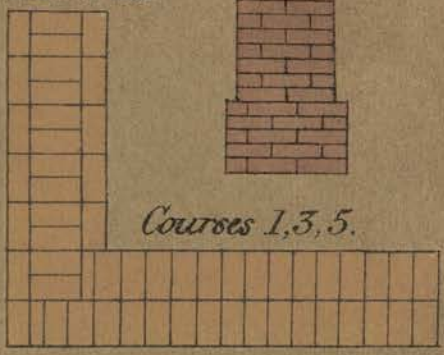
Courses 2,4,6.



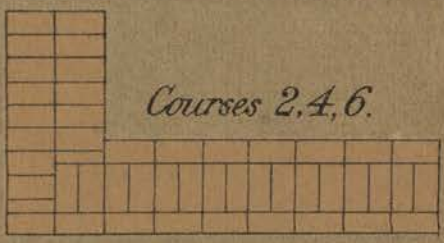
2 Brick Wall

Section

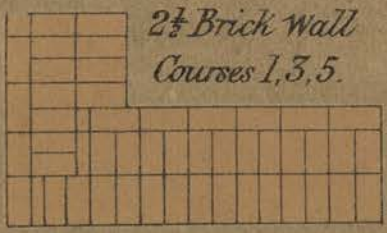
Courses 1,3,5.



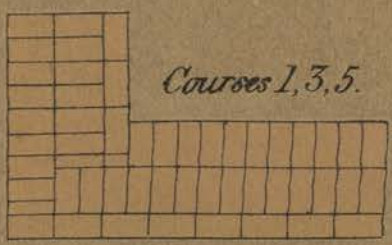
Courses 2,4,6.



2½ Brick Wall
Courses 1,3,5.



Courses 1,3,5.



Govt. Photozinco. Office, Poona. 1882.

XLV.—Brick Nogging.

Description of work.

1. This description of work, which will be 6 inches only in thickness, will consist of a combination of teak posts and planking, the interspaces being filled in with brick-work, 1st class (Specification No. XLII), and finally plastered with lime on both faces.

Network of Timber.

2. The uprights or posts will measure 6″ × 5″ and be placed at central distances of 5 feet apart. Between these posts and notched into them there will be horizontal ribs of teak planking 6″ × 2″ fixed at 3 feet vertical distances apart. Between these latter, cross braces or diagonals 6″ × 1½″ will be inserted, halved together at points of intersection and spiked to the posts.

Interspaces.

3. All interspaces will then be filled in with brick and lime masonry, built up flush with the outer faces of the timber framework. Bricks to be of same breadth as thickness of post.

Plastering.

4. After the completion of the walling the surfaces of the work to be thoroughly wetted and nails driven into the timber framework to give a hold to the mortar plaster with which both faces of the work should then be finished off.

ARCHING SPECIFICATIONS.

XLVI.—Ashlar Arching.

1. The arch stones shall be dressed full and true to their proper shapes with the necessary summering, twist, or winding, and shall be carefully set in good fine mortar.

Dressing beds.

2. The entrados, joints and beds to be fairtooled, and all horizontal joints across the entrados to have a ¾″ chamfer to prevent the arises chipping.

Face stone.

3. The face stones may be tooled, or rockfaced, with or without chamfer, as may be specified.

Size of stones.

4. The arch stones shall not be less than 10″ on their least dimension, and shall break joint at least 9″. In archings up to 2′ in thickness, the stones shall all be of the full thickness of the ring. In arches from 2′ to 3′ in thickness, the stones shall be laid header and stretcher alternately, all the headers being of the full depth of the ring and not more than two stretchers going to make up thickness of ring.

In arches over 3′ in depth the quoins and key stones alone need be of the full thickness of the ring. The stones when laid double, as above, to form the ring, shall be laid in such bond as may be directed.

Exact uniformity will be required in the thickness of each course of arch stones, and in oblique or skew arches great care is to be taken to dress the beds to the required winding.

5. The bed joint shall be perpendicular to the tangent of the curve of the arch at each point, and the side joints shall be at right angles to the face and bed joints, and the thickness of the joints shall not exceed $\frac{3}{16}$″.

Joints.

6. The mortar of the joints on face and soffit of arch to be raked out when centering is removed, and neatly pointed with good mortar or cement.

Note.—Suitable for bridges over 60' span.

XLVII.—Block in Course Arching.

1. Shall be precisely similar to the above, except that the stones shall not be less than 6″ on their least dimension, and shall not break joint less than 6″, and shall only be rough-tooled on beds and joints, which shall not exceed $\frac{1}{4}$″ in thickness.

Note.—Suitable for bridges from 30' to 60' for verandah arches in barracks, &c. &c.

XLVIII.—Rubble Arching.

1. Shall consist of flat bedded hammer dressed slabs laid solidly and flush in mortar with their beds perpendicular to tangent to the curve of the arch, and shall properly break joint and bond with each other.

2. The joints on face and soffit shall not exceed $\frac{3}{8}$″ in thickness. The backs of the stones when open shall be solidly wedged up with spauls and chips of stone set in mortar.

Joints.

3. The arch quoins to be of the same thickness as the sheeting of the course, but they shall be superior selected stones, in all cases extending right through from entrados to extrados, and alternately, not less than 15″ and 21″ long, upon the intrados or bed face.

Quoins.

4. No arch stone in the sheeting shall be less than 3″ on its least dimension, and the stones shall break joint with each other at least 6″. In arch rings 15″ thick and under, all stones shall be of the full thickness of the ring.

Size of arch stones.

In arch rings more than 15″ thick, the stones will be laid in alternate courses of headers and stretchers, unless otherwise specified; not more than two stones going to make up the thickness of the arch ring.

Bond.

The joints on face and soffit to be raked out when the centering is removed, and neatly pointed with good mortar or cement.

Note.—Suitable for arches up to 30' span.

XLIX.—Brick Arching for Bridges.

1. The bricks to be, as in 1st class brickwork, laid in concentric half brick rings.

Half brick rings.

Joints. 2. The voussoir joints are to be properly summered, and not to exceed $\frac{3}{8}''$ in thickness.

Skew backs 3. Bricks forming skew back-joints are to be moulded or cut so as to radiate truly.

Bond of rings. 4. Great care to be taken that the rings are bonded together properly, whenever the joints of any of the rings come to a summering, or plane face.

L. and LI.—Brick Arching over doors and windows.

As above, but bricks as in 2nd class brick-work and joints not to exceed $\frac{1}{2}''$.

CONCRETE SPECIFICATIONS.

LII.—Concrete of Shingle or Road Metal.

Proportion. 1. Shall consist (unless otherwise specified) of—

Slaked lime	...	...	1 part.
Clean sharp sand	...	...	2 parts.
Screened shingle	...	...	5 ,,

Note.—If shingle is not obtainable, 3 parts of road metal, $1\frac{1}{2}''$ guage, may be used instead.

Mixing. 2. The lime and sand to be made into mortar in the usual manner, and then thoroughly incorporated with the shingle (or metal), adding, if required, a little water as in No. LIV.

Layers. 3. The concrete shall be laid in the work in layers not exceeding 9″ in depth, and shall be well rammed with heavy wooden or iron rammers.

Grouting. 4. If the lime does not fill all the spaces between the stones and cream to the surface, the top of each layer is to be grouted with thin mortar before the next layer is laid.

LIII.—Concrete of broken brick and kunker.

Proportion. 1. Shall consist (unless otherwise specified) of—

Lime slaked	...	...	1 part.
Kunkur chunam	...	..	2 parts
Clean sharp sand	...	...	1 part.
Broken bricks	...	...	2 parts.

General. 2. In all other respects as regards mixing, depth of layers and grouting to be as in Specification No. LII above.

LIV.—Cement Concrete.

1. Portland Cement	...	...	1 part.
Sand	...	...	2 parts.
Screened shingle	...	...	5 ,,

Note.—4 parts of road metal, $1\frac{1}{4}''$ guage, may be substituted.

2. To be mixed dry immediately before use. When thoroughly mixed, water to be added through the rose of a watering pot only in such quantity as to ensure its thoroughly setting. The volume of water required will probably be about ½ the volume of the cement.

Mixing.

3. The concrete must be used within three hours of its being wetted. If to be kept more than three hours after being mixed, great care shall be taken that the sand and shingle are thoroughly dried beforehand, and that no water or wet reaches it.

Keeping.

PROBABLE COST OF EXECUTING WORKS ACCORDING TO THE ABOVE SPECIFICATIONS.

XXVI.—Ashlar—Fine.

Artificers, Labourers, and Materials for 100 Cubic Feet.	No. or quantity.	Rate.			Amount		No. or quantity.	Rate.			Amount	
		Rs.	a.	Per	Rs.	a.		Rs.	a.	Per	Rs.	a.
Materials.												
Stone, Rough, 12″ thick, averaging 4½ C. F. each ... C. F.	100	0	6	C. F.	37	8						
Lime, slaked C. F.	8	12	0	40 C. F.	2	6						
Sand, fine ... C. F.	8	2	0	100 C. F.	0	3						
Charcoal ... lbs.	120	1	0	80 lbs.	1	8						
Iron, &c. ... lbs.	8	1	0	8 lbs.	1	0						
Sundries ...	...	...		...	1	0						
Total Materials.					43	9						
Labour.												
Masons, 1st Class, for dressing .	44	0	12	each.	33	0						
Do. do. setting.	12	0	12	do.	9	0						
Nowgunnies	12	0	5	do.	3	12						
Coolies	2	0	3	do.	0	6						
Women	6	0	2	do.	0	12						
Bhisties	½	0	8	do.	0	2						
Smiths	2	0	12	do.	1	8						
Bellows-boys	2	0	4	do.	0	8						
Grinding chunam C. F.	10	4	0	100 C. F.	0	6						
Scaffolding	...	...		...	2	0						
Sundries	...	...		...	1	0						
Total Labour...					52	6						
Total for 100 C. F...					95	15		Total for 100 C. F.				

N.B.—If thicker courses were used, the stone will cost more, say about 8 annas per foot for 15″ courses, 10 annas a foot for 18″ courses, &c.

In using thicker courses of larger stones, the surface to be dressed will be less, but the extra cost of handling larger stones will be more, so that no reduction can be made in cost of labour. This above applies to the harder description of Poona stone.

If of basalt, such as, in Bombay, Nowrojee Hill, half as much more labour will be required for dressing.

XXVII.—Ashlar Rough-tooled.

Artificers, Labourers, and Materials for 100 Cubic Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a Per	Rs. a.
Stones, Rough, 12″ thick averaging 4½ C. F. each ... C. F.	100	0 6 C. F.	37 8			
Lime, slaked C. F.	12	12 0 40 C. F.	3 10			
Sand ... C. F.	18	2 0 100 C. F.	0 6			
Charcoal ... lbs.	90	1 8 80 lbs.	1 2			
Iron ... lbs.	4	1 0 8 lbs.	0 8			
Sundries	...	... ...	1 0			
		Total Materials.	44 2			
Labour.						
Masons, 1st Class, for dressing...	25	0 12 each	18 12			
Do. for setting ...	12	0 12 do.	9 0			
Nowgunnies	12	0 5 do.	3 12			
Coolies	2	0 3 do.	0 6			
Women	6	0 2 do.	0 12			
Bhisties	¼	0 8 do.	0 2			
Smiths	1½	0 12 do.	1 2			
Bellows-boys	1½	0 4 do.	0 6			
Grinding chunam C. F.	18	3 0 100 C. F.	0 8			
Scaffolding	...	... ...	2 0			
Sundries	...	... ...	1 0			
		Total Labour...	37 12			
		Total for 100 C. F. ...	81 14		Total for 100 C. F...	

N.B.—The same remarks as for Ashlar fine are applicable to this.

XXVIII.—Ashlar, Rock, Rustic or Quarry-faced.

Artificers, Labourers, and Materials for 100 Cubic Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a		Rs. a. Per	Rs. a.
Materials.						
Same as above ...	...	... ...	44 2			
Labour.						
Masons, 1st Class, for dressing	22	0 12 each.	16 8			
Rest same as above ..	...	... ...	19 0			
		Total Labour...	35 8			
		Total for 100 C. F...	79 10		Total for 100 C. F...	

N.B.—The same remarks as for Ashlar fine are applicable to this.

XXIX.—Ashlar—Chamfered.

Artificers, Labourers, and Materials for 100 Cubic Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a
Same as for Ashlar rough-tooled ...	...	... ...	44 2			
Labour.						
Masons for dressing ...	27	0 12 each.	2 40			
Rest same as for Rustic Ashlar	...	... ...	19 0			
		Total Labour...	39 4			
		Total for 100 C. F...	83 6		Total for 100 C. F...	

N.B.—The same remarks as for Ashlar fine are applicable to this.

XXX.—Ashlar Facing.

Artificers, Labourers, and Materials for 100 Cubic Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Stones, Rough, 12″ thick, averaging 4 C. F. each ... C. F.	125	0 5 C. F.	39 1			
Lime, slaked, C. F.	16	12 0 40 C. F.	4 13			
Sand ... C. F.	24	2 0 100 C. F.	0 8			
Charcoal ... lbs.	60	1 0 80 lbs.	0 12			
Iron ... lbs.	3	1 0 8 lbs.	0 6			
Sundries	...	... ...	1 0			
		Total Materials.	46 8			
Labour.						
Masons, for dressing ...	15	0 12 each.	11 4			
Do. setting ...	10	0 12 do.	7 8			
Nowgunnies ...	12	0 5 do.	3 12			
Coolies	2	0 3 do.	0 6			
Women	6	0 2 do.	0 12			
Bhisties	½	0 8 do.	0 4			
Smiths	1	0 12 do.	0 12			
Bellows-boys ...	1	0 4 do.	0 4			
Grinding chunam C. F.	24	3 0 100 C. F.	0 11			
Scaffolding	...	... ...	2 0			
Sundries	...	... ...	1 0			
		Total Labour...	28 9			
Total for 100 C. F. ...			75 1	Total for 100 C. F...		

N. B.—The same remarks as for Ashlar fine are applicable to this.

Bond stones through the backing should be calculated separately or in the backing.

XXX (*a*).—Ashlar Facing rustic with chisel draft.

Artificers, Labourers, and Materials for 100 Cubic Feet,	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs a.		Rs. a. Per	Rs. a.
Same as for Ashlar facing rough-tooled ...	...	... ...	46 8			
Labour.						
Masons for dressing. ...	12	0 12 each.	9 0			
Rest same as for Ashlar facing rough-tooled .	...	... ...	17 5			
		Total Labour ...	26 5			
Total for 100 C. F. ...			72 13	Total for 100 C.F...		

N.B.—The same remarks as for Ashlar facing rough-tooled are applicable to this.

XXX (*b*).—Ashlar Facing chamfered.

Artificers, Labourers, and Materials for 100 Cubic Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Same as for Ashlar facing rough-tooled .	...	... ...	46 8			
Labour.						
Masons for dressing....	17	0 12 each.	12 12			
Rest same as for Ashlar facing rough-tooled .	...	... ...	17 5			
		Total Labour ...	30 1			
Total for 100 C. F. ...			76 9	Total for 100 C. F....		

XXXI.—Block in Course.

Artificers, Labourers, and Materials for 100 Cubic Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Stone, Rough, 9" high C.F	100	0 4 foot	25 0			
Lime, slaked C.F.	13	12 0 40 C. F.	3 14			
Sand ... C.F.	20	2 0 100 C. F.	0 6			
Charcoal ... lbs.	90	1 0 80 lbs.	1 2			
Iron ... lbs.	4	1 0 8 lbs.	0 8			
Sundries	...	... ...	1 0			
		Total Materials.	31 14			
Labour.						
Same as for Ashlar rough-tooled ...	...	... ...	37 12			
Total for 100 C. F. ...			69 10	Total for 100 C.F. ...		

XXXII.—Block in Course Facing.

Artificers, Labourers, and Materials for 100 Cubic Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Stone, Rough, about 1¼" C. F. each, and 9" high...	125	20 0 100 C. F.	25 0			
Rest same as for Ashlar facing rough-tooled .	...	... ...	7 7			
		Total Materials.	32 7			
Labour.						
Same as for Ashlar facing rough-tooled .	...	... ...	28 9			
Total for 100 C. F. ...			61 0	Total for 100 C.F. ...		

XXXIII.—Coursed Rubble, 1st Sort.

Artificers, Labourers, and Materials for 100 Cubic Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Headers or through stones ... ...No.	25	9 0 100 No.	2 4			
Rubble stone, large C.F.	100	5 0 100 C. F.	5 0			
Lime, slaked .. C.F.	16	12 0 40 C. F.	4 13			
Sand ... ...C.F.	24	2 0 100 C. F.	0 8			
Sundries	...	... ...	0 12			
		Total Materials.	13 5			
Labour.						
Masons, 2nd Class, for dressing ...	6	0 10 each.	3 12			
Do. 2nd Class, for setting	5	0 10 do.	3 2			
Coolies	5	0 3 do.	0 15			
Women	5	0 2 do.	0 10			
Grinding chunam C.F.	24	3 0 100 C. F.	0 11			
Bhisties	½	0 8 each.	0 4			
Smiths...	¼	0 12 do.	0 3			
Bellows-boys	¼	0 4 do.	0 1			
Scaffolding	...	... ...	1 0			
Sundries	...	... ...	0 12			
		Total Labour...	11 6			
		For 100 C.F. ...	24 11		Total for 100 C.F....	

XXXIV.—Coursed Rubble, 2nd Sort.

Artificers, Labourers, and Materials for 100 Cubic Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Headers or through stones ... ...No.	19	9 0 100 No.	1 11			
Rubble stone, large C.F.	50	5 0 100 C. F.	2 8			
Do. small C.F.	50	3 0 100 C. F.	1 8			
Lime, slaked ...C.F.	20	12 0 40 C. F.	6 0			
Sand ... .C.F.	30	2 0 100 C. F.	0 10			
Sundries	...	.....	0 10			
		Total Materials.	12 15			
Labour.						
Masons, 2nd Class, for dressing	3	0 10 each	1 14			
Masons, 2nd Class, for setting	5	0 10 do.	3 2			
Coolies...	5	0 3 do.	0 15			
Women	5	0 2 do.	0 10			
Grinding chunam C. F.	30	3 0 100 C. F.	0 14			
Bhisties	½	0 8 each.	0 4			
Smiths	⅛	0 12 do.	0 1			
Bellows-boys	⅛	0 4 do.	0 1			
Scaffolding	...	... ...	1 0			
Sundries	...	... ...	1 0			
		Total Labour...	9 13			
		For 100 C. F. ...	22 12		Total for 100 C.F....	

XXXV.—Coursed Rubble, 3rd Sort.

Artificers, Labourers, and Materials for 100 Cubic Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Headers or through stones ... ...No.	13	9 0 100 No.	1 3			
Rubble stone C.F.	80	3 0 100 C.F.	2 6			
Lime ... C.F.	20	12 0 40 C.F.	6 0			
Sand ... C.F.	30	2 0 100 C.F.	0 10			
Sundries	...	.....	0 8			
		Total Materials.	10 11			
Labour.						
Masons for setting, 2nd Class	5	0 10 each	3 2			
Coolies	5	0 3 do.	0 15			
Women	5	0 2 do.	0 10			
Grinding chunam C.F.	30	3 0 100 C.F.	0 14			
Bhisties	½	0 8 each	0 4			
Scaffolding		.....	1 0			
Sundries		.....	0 8			
		Total Labour...	7 5			
		Total for 100 C.F. ...	18 0		Total for 100 C. F.	

XXXVI.—Random Rubble, 1st Sort.

Artificers, Labourers, and Materials for 100 Cubic feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Quoins ... No.	4	0 7 each	1 12			
Headers or through stones ... ...No.	9	9 0 100 No.	0 13			
Rubble stone C. F.	120	4 0 100 C. F.	4 13			
Lime, slaked C. F.	12	12 0 40 C. F.	3 10			
Sand ... C. F.	18	2 0 100 C. F.	0 6			
Charcoal ... lbs.	20	1 0 80 lbs.	9 4			
Sundries	...	.....	0 12			
		Total Materials.	12 6			
Labour.						
Masons, 2nd Class ...	16	0 10 each	10 0			
Coolies	5	0 3 do.	0 15			
Women	5	0 2 do.	0 10			
Bhisties	¼	0 8 do.	0 2			
Smiths	½	0 12 do.	0 6			
Bellows-boys ...	½	0 4 do.	0 2			
Grinding chunam C.F.	18	3 0 100 C.F.	0 9			
Scaffolding	...	.....	1 0			
Sundries	...	.....	0 12			
		Total Labour .	14 8			
		Total for 100 C.F. ...	26 14		Total for 100 C.F....	

XXXVII.—Random Rubble, 2nd Sort.

May be taken as much as coursed rubble, 2nd sort.

XXXVIII.—Uncoursed Rubble.

Materials and Labour.	No. or quantity.	Rate.			Amount		No. or quantity.	Rate.			Amount	
Materials.		Rs.	a.	Per	Rs.	a.		Rs.	a.	Per	Rs.	a.
Headers or through stones ... ...No.	12	9	0	100	1	1						
Rubble stone, large C.F.	50	5	0	100	2	8						
Do. small C.F.	70	3	0	100	2	2						
Lime, slaked C.F.	20	12	0	40	6	0						
Sand ... C.F.	30	2	0	100	0	10						
Sundries	...		.....		0	8						
		Total Materials.			12	13						
Labour.												
Masons, 2nd Class No.	4	0	10	each	2	8						
Coolies ... No.	4	0	3	do.	0	12						
Women ... No.	2	0	2	do.	0	4						
Grinding chunam C.F.	30	3	0	100	0	14						
Bhisties ... No.	½	0	8	each	0	4						
Scaffolding... ...	...		.....		1	0						
Sundries	...		.....		0	8						
		Total Labour...			6	2						
Total for 100 C.F. ...					18	15	Total for 100 C.F. ...					

XXXIX.—Stone and Mud Masonry.

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Rubble stone ... C. F.	150	3 0 100	4 8			
Earth ... ... C. F.	24	2 8 100	0 10			
Sand ... ... C. F.	12	2 0 100	0 4			
Sundries	...	.....	0 6			
		Total Materials.	5 12			
Labour.						
Masons, 2nd Class No.	2	0 10 each.	1 4			
Coolies ... ... No.	2	0 3 do.	0 6			
Women ... ... No.	1	0 2 do.	0 2			
Bhisties ... ... No.	¼	0 8 do.	0 2			
Sundries	...	.....	0 6			
		Total Labour...	2 4			
		Total for 100 C. F.	8 0		Total for 100 C.F.	

XL.—Dry Stone Masonry.

Material and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Headers or through stones ... ... No.	10	9 0 100	0 14			
Rubble stone ... C. F.	125	5 0 100	6 4			
Sundries	...	.....	0 8			
		Total Materials.	7 10			
Labour.						
Masons, 2nd Class No.	3	0 10 each.	1 14			
Coolies ... ... No.	1	0 3 do.	0 3			
Women ... ... No.	2	0 2 do.	0 4			
Sundries	...	.....	0 9			
		Total Labour...	2 14			
		Total for 100 C. F. ...	10 8		Total for 100 C.F.	

XLI.—Dry Rubble Retaining Walls.

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Headers or through stones ... . No.	10	9 0 100	0 14			
Rubble stone ... C. F.	120	3 0 100	3 10			
Gunpowder ... Lbs.	8	0 3 lbs.	1 8			
Sundries	...	.....	0 4			
		Total Materials	6 4			
Labour.						
Masons, 2nd Class No.	4	0 10 each.	2 8			
Coolies ... ... No.	4	0 3 do.	0 12			
Smiths ... ... No.	½	0 12 do.	0 6			
Sundries	...	.....	0 4			
		Total Labour...	3 14			
		Total for 100 C. F. ...	10 2		Total for 100 C.F.	

Note.—The above rate is for walls not exceeding 30 feet in height.

XLII.—Brick-work, 1st Class.

Artificers, Labourers, and Materials for 100 Cubic Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Bricks, 9″ × 4½″ × 2½″, allowing 5 per cent. for wastage ... No.	1520	12 0 1,000	18 4			
Lime, slaked ... C. F.	16	12 0 40 C. F.	3 10			
Sand ... ... C. F.	24	2 0 100 C. F.	0 8			
Sundries	...	.....	0 6			
		Total Materials	23 15			
Labour.						
Bricklayers ... No.	6	0 10 each.	3 12			
Coolies ... ... No.	2	0 3 do.	0 6			
Women ... ... No.	6	0 2 do.	0 12			
Bhisties ... ... No.	½	0 8 do.	0 4			
Grinding chunam. C. F.	24	3 0 100 C. F.	0 11			
Sundries	...	.....	0 6			
Scaffolding up to 12 ft. in height	...	.....	1 0			
		Total Labour...	7 3			
Total for 100 C. F. when the wall is 12 feet in height.			31 2		Total for 100 C.F. when the wall is 12 feet in height.	

N.B.—When the wall is higher, add for every aditional 5 feet in height annas eight per 100 C. F. to the whole cost; thus rate—

	Rs. a.
For 12 feet	31 2
For 17 feet	31 10
For 22 feet	32 2

and so on.

XLIII.—Brick-work, 2nd Class.

Artificers, Labourers and Materials for 100 Cubic Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Bricks, 9″ × 4¼″ × 2½″, allowing 5 per cent. for wastage	1,410	8 0 1,000	11 4			
Lime, slaked	20	12 0 40 C. F.	6 0			
Sand	30	2 0 100 C. F.	0 10			
Sundries	...	.....	0 6			
		Total Materials.	18 4			
Labour.						
Bricklayers	4	0 10 each.	2 8			
Coolies	2	0 3 do.	0 6			
Women	6	0 2 do.	0 12			
Bhisties	½	0 8 do.	0 4			
Grinding chunam C. F....	30	3 0 100 C. F.	0 14			
Scaffolding	...	.....	1 0			
Sundries	...	.....	0 6			
		Total Labour...	6 2			
		Total for 100 C. F. ...	24 6		Total for 100 C. F.	

N.B.—The remark as for Brick-work, 1st Class, page 49, is applicable to this.

XLIV.—Brick and Mud Work.

Artificers, Labourers, and Materials for 100 Cubic Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Bricks 9″ × 4¼″ × 2½″ allowing 5 per cent. for wastage	1,300	8 0 1,000 No.	10 6			
Mud ... ... C.F.	30	1 8 100 C.F.	0 7			
Sundries	...	.....	0 3			
		Total Materials.	11 0			
Labour.						
Bricklayers ... No.	4	0 10 each.	2 8			
Coolies	3	0 3 do.	0 9			
Women	6	0 2 do.	0 12			
Bhisties	½	0 8 do.	0 4			
Sundries	...	.....	0 3			
Scaffolding	...	.....	1 0			
		Total Labour...	5 4			
		Total for 100 C. F. ...	16 4		Total for 100 C.F.	

XLV.—Brick Nogging.

Materials and Labour.	No. or quantity.	Rate.			Amount		No. or quantity.	Rate.		Amount	
		Rs.	a.	Per	Rs.	a.		Rs.	a. Per	Rs.	a.
Materials.											
Teakwood ... C.F.	7·16	3	0	C.F.	21	8					
Nails, &c.	...		.....		0	8					
Burnt brick masonry, 2nd class ... C.F.	30	24	6	100	7	5					
Sundries	...		.....		0	4					
		Total Materials.			29	9					
Labour.											
On wrought timber. C.F.	7·16	0	6	C.F.	2	11					
Sundries	...		.....		0	4					
		Total Labour...			2	15					
Add.											
Plastering both sides. S.F.	120	7	7	100	8	15					
		Total for 60 S.F.			41	7					
		Total for 100 S. F....			69	1					

XLVI.—Ashlar Arching.

Artificers, Labourers, and Materials for 100 Cubic Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Stones, rough, averaging $4\frac{1}{6}$ C. F. each C.F.	100	0 6 foot	37 8			
Lime, slaked ... C.F.	10	12 0 40 C. F.	3 0			
Sand ... ... C.F.	10	2 0 100 C. F.	0 3			
Charcoal ... ... lbs.	140	1 0 80 lbs.	1 12			
Iron ... ... lbs.	8	1 0 8 lbs.	1 0			
Sundries		.....	1 0			
		Total Materials.	44 7			
Labour.						
Masons for dressing (1st class), 2 Masons for a stone	48	0 12 each.	36 0			
Do. for setting ...	12	0 12 do.	9 0			
Nowgunnies.	12	0 5 do.	3 12			
Coolies	2	0 3 do.	0 6			
Women	6	0 2 do.	0 12			
Bhisties	$\frac{1}{4}$	0 8 do.	0 2			
Smiths	$2\frac{1}{2}$	0 12 do.	1 14			
Bellows-boys	$2\frac{1}{2}$	0 4 do.	0 10			
Grinding chunam C.F.	10	4 0 100 C.F.	0 6			
Scaffolding		.....	2 0			
Sundries...		.....	1 0			
		Total Labour...	55 14			
		Total for 100 C.F. ...	100 5		Total for 100 C.F.	

XLVII.—Block in Course Arching.

Artificers, Labourers, and Materials for 100 Cubic Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Stones, rough ...C. F.	100	0 4 foot	25 0			
Lime, slaked ...C. F.	13	12 0 40 C. F.	3 14			
Sand ... ...C. F.	20	2 0 100 C. F.	0 6			
Charcoal ... ... lbs.	90	1 0 80 lbs.	1 2			
Iron ... ... lbs.	4	1 0 8 lbs.	0 8			
Sundries	...	.....	1 0			
		Total Materials.	31 14			
Labour.						
Masons for dressing ...	25	0 12 each.	18 12			
Do. for setting ...	12	0 12 do.	9 0			
Nowgunnies	12	0 5 do.	3 12			
Coolies...	2	0 3 do.	0 6			
Women	6	0 2 do.	0 12			
Bhisties	¼	0 8 do.	0 2			
Smiths...	1½	0 12 do.	1 2			
Bellows-boys	1½	0 4 do.	0 6			
Grinding chunam C. F.	20	3 0 100 C. F.	0 10			
Scaffolding	...	.....	2 0			
Sundries	...	.....	1 0			
		Total Labour ...	37 14			
		Total for 100 C. F. ...	69 12		Total for 100 C. F.	

XLVIII.—Rubble Arching

Artificers, Labourers, and Materials for 100 Cubic Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs.
Slabs, rough, about $1\frac{1}{2}' \times 1' \times \frac{1}{2}'$ each C. F.	100	12 8 100 C. F.	12 8			
Lime, slaked ... C. F.	16	12 0 40 C. F.	4 13			
Sand ... C. F.	24	2 0 100 C. F.	0 8			
Charcoal ... lbs.	30	1 0 80 lbs.	0 6			
Sundries	...	... ...	0 12			
		Total Materials .	18 15			
Labour.						
Masons, 2nd class, for dressing	10	0 10 each.	6 4			
Do. for setting ...	6	0 10 do.	3 12			
Nowgunnies ...	6	0 5 do.	1 14			
Coolies	2	0 3 do.	0 6			
Women	6	0 2 do.	0 12			
Bhisties	$\frac{1}{2}$	0 8 do.	0 4			
Smiths	$\frac{1}{2}$	0 12 do.	0 6			
Bellows-boys ...	$\frac{1}{2}$	0 4 do.	0 2			
Grinding chunam C. F.	24	3 0 100 C. F.	0 11			
Scaffolding	...	... ...	1 0			
Sundries	...	... ...	0 12			
		Total Labour ...	16 3			
		Total for 100 C. F. ...	35 2		Total for 100 C. F....	

Note.—The following is a rough rule for cost of centering, including erecting and lowering, labour of constructing ribs, &c., wastage on timber used, sand-boxes, &c.

Span in feet.	Cost per running foot of Span.	Total Cost.	Span in feet.	Cost per running foot of Span.	Total Cost.
	Rs. a. p.	Rs. a. p.		Rs. a. p.	Rs. a. p.
10	5 0 0	50 0 0	45	12 8 0	562 8 0
15	5 0 0	75 0 0	50	15 0 0	750 0 0
20	7 8 0	150 0 0	55	15 0 0	825 0 0
25	7 8 0	187 8 0	60	20 0 0	1,200 0 0
30	10 0 0	300 0 0	65	20 0 0	1,300 0 0
35	10 0 0	350 0 0	70	25 0 0	1,750 0 0
40	12 8 0	500 0 0	75	25 0 0	1,875 0 0

XLIX.—Brick Arching for Bridges.

May be taken as brick-work under XLIII, adding for centering as in page 55.

L.—Brick Arching over doors and windows, 1st Class.

Artificers, Labourers, and Materials for 100 Cubic Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials,						
Bricks 9″ × 4½″ × 2½″ allowing 5 per cent. for wastage ...	1550	12 0 1,000	18 10			
Lime, slaked ... C. F.	16	12 0 40 C. F.	4 13			
Sand ... C. F.	24	2 0 100 C. F.	0 8			
Timber for centering...	...	... ...	0 4			
Sundries	...	... ...	0 6			
		Total Materials .	24 9			
Labour.						
Bricklayers for laying .	6	0 10 each.	3 12			
Do. for dressing bricks ...	4	0 10 do.	2 8			
Coolies	2	0 3 do.	0 6			
Women	6	0 2 do.	0 12			
Bhisties	½	0 8 do.	0 4			
Carpenter for centering	½	0 12 do.	0 6			
Grinding chunam. C. F.	24	3 0 C. F.	0 11			
Sundries	...	... ..	0 6			
Scaffolding	...	... ...	1 0			
		Total Labour ...	10 1			
		Total for 100 C. F. ...	34 10		Total for 100 C. F....	

LI.—Brick arching over doors and windows, 2nd Class.

Artificers, Labourers, and Materials for 100 Cubic Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Bricks 9″ × 4¼″ × 2½″ ...	1425	8 0 1,000	11 6			
Lime, slaked ... C. F.	20	12 0 40 C. F.	6 0			
Sand ... C. F.	30	2 0 100 C. F.	0 10			
Timber for centering...	...	... ...	0 4			
Sundries	...	... ...	0 4			
		Total Materials .	18 8			
Labour.						
Brick-layers for laying.	5	0 10 each.	3 2			
Do. for dressing.	3	0 10 do.	1 14			
Coolies	2	0 3 do.	0 6			
Women	6	0 2 do.	0 12			
Bhisties	½	0 8 do.	0 4			
Grinding chunam C. F.	30	3 0 100 C. F.	0 14			
Carpenter for centering	½	0 12 each.	0 6			
Scaffolding	...	... ...	1 0			
Sundries	...	... ...	0 5			
		Total Labour ...	8 15			
		Total for 100 C. F....	27 7		Total for 100 C. F....	

LII.—Concrete of Road Metal.

Artificers, Labourers, and Materials for 100 Cubic Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Road Metal ... C. F.	84	6 0 100 C. F.	5 0			
Sand ... C. F.	56	2 0 do.	1 2			
Lime, slaked ... C. F.	28	12 0 40 C. F.	8 6			
Sundries	...	... ...	0 3			
		Total Materials .	14 11			
Labour.						
Grinding chunam C.F.	56	3 0 100 C. F.	1 10			
Coolies ... No.	8	0 3 each.	1 8			
Bhisties	½	0 8 do.	0 4			
Sundries	...	... ...	0 3			
		Total Labour ..	3 9			
Total for 100 C. F. Road metal, concrete...			18 4		Total for 100 C. F. Road metal, concrete.	

LIII.—Concrete of broken brick and kunker.

Artificers, Labourers, and Materials for 100 Cubic Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Broken bricks ...C. F.	50	5 0 100 C. F.	2 8			
Kunker chunam...C. F.	50	5 0 100 C. F.	2 8			
Sand ...C. F.	25	2 0 100 C. F.	0 8			
Lime, slaked ...C. F.	25	12 0 40 C. F.	7 8			
Sundries	...	... ...	0 3			
		Total Materials.	13 3			
Labour.						
Grinding chunam C. F.	25	3 0 100 C. F.	0 12			
Coolies	8	0 3 each.	1 8			
Bhisties	¾	0 8 do.	0 6			
Sundries	...	... ...	0 3			
		Total Labour...	2 13			
Total for 100 C. F. broken brick and kunker, concrete			16 0		Total for 100 C. F. broken brick and kunker, concrete...	

LIV.—Cement Concrete.

Artificers, Labourers, and Materials, for 100 Cubic Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Road Metal... C. F.	96	6 0 100 C. F.	5 12			
Sand ... C. F.	48	2 0 do.	1 0			
Portland Cement, 6 casks or ... C. F.	24	12 0 4 C. F.	72 0			
Sundries	...	... ...	0 4			
		Total Materials .	79 0			
Labour.						
Coolies ... No.	6	0 3 each.	1 2			
Bhisties	1	0 8 do.	0 8			
Sundries	...	... ...	0 4			
		Total Labour ...	1 14			
Total for 100 C. F. of concrete of cement.			80 14		Total for 100 C. F. concrete of cement.	

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IV.—FLOORING SPECIFICATIONS.

LV.—Paving, 1st Sort.

Filling. 1. The moorum filling to be levelled, watered, and well rammed before the concrete is put in.

Concrete. 2. A concrete substratum to be laid 6″ thick, when thoroughly rammed. Concrete to be as in Specification No. LII.

Dressing. 3. The stones to be very finely flat chisel-dressed on the surface, and the courses to be of uniform width, so that the joints may run true and parallel from side to side.

Joint. 4. The stones to be laid with joints not exceeding $\frac{1}{8}$″ in thickness, and to be evenly and firmly bedded flush in mortar on the concrete, and no hollows to be left.

Size. 5. The stones to be 3″ or 4″ thick, and not less in length and breadth than 12″ × 12″ laid to a perfectly smooth and level surface.

Vertical joints. 6. Vertical joints to be dressed true and square for at least 1½″ from face.

Note.—Suitable for architectural buildings.

LVI.—Paving, 2nd Sort.

As above, but not quite so finely dressed, joints may be $\frac{3}{16}$″ thick and dressed true 1″

Note.—Suitable for barracks.

LVII.—Paving, 3rd Sort.

As above, but only rough point chisel-dressed, with ¼″ joints and true for ½″, and size of stones to be not less than 12″ × 6″. Concrete 3″ thick when rammed.

LVIII.—Paving, 4th Sort.

Irregular-shaped and sized stones roughly dressed, with point chisel, joints ⅜″ true for ½″. Concrete 3″ thick when rammed.

Note.—The last two sorts are only suited for minor buildings, such as cook-houses, dharmshálas, &c.

LIX.—Paving for upper story, 1st Sort.

1. To be laid over joists, to be of thin slabs of uniform thickness (if of Porebandar stone to be not less than 2½″ thick), dressed true and square on the edges to make close joints ⅛″ for the full thickness of the stone.

Slabs.

2. The surface to be as for paving, 1st sort. The stones to be of such length and breadth that the joints shall come exactly in the middle of the joists, and that the cross joints shall be in a straight line.

Size.

3. The joints to be made with Portland cement.

Cement joints.

Note.—If the slabs are to be under concrete for floors or roofs, the upper side need not be dressed, and the stones can be set in ordinary mortar, and joints can be ¼″ thick.

LX.—Paving upper story, 2nd sort.

Same as above generally, but the surface of the slabs to be dressed as for paving 2nd sort, and the edges true and square to make joints $\frac{3}{16}$″ for the full thickness of the stone.

LXI and LXII.—Brick or tiled floor.

1. The bricks or tiles will be laid on 6″ of concrete. The joints to be rubbed, and the hardest and best burnt bricks to be selected. To be thoroughly wetted and set in lime mortar.

2. Bricks to be laid on edge or flat as may be specified for particular work.

LXIII.—Chunam or Terraced Floors.

1. The moorum filling to be levelled, watered, and well rammed before the concrete is put in.

Filling.

2. The floor will be composed of concrete as in Specification No. LII 6″ thick when consolidated. The concrete to be rammed well for three consecutive days with wooden or iron beaters: three coolies at least per day to be employed per square.

Consolidation.

3. When the consolidation is considered by the Executive Engineer to be complete, finish with a coat of plaster at least ¾″ thick and beat surface with flat beaters for three days: three coolies at least per day to be employed per square. The plaster to contain such proportions of masala as may be directed.

Plaster.

LXIV.—Asphalt Flooring.

1. To be laid on a concrete floor as per paras. 1 and 2 of Specification No. LXIII above, which must be perfectly dry before the asphalt is laid.

Substructure.

2. All dust and sand should first be cleared off the site, and the asphalt having been mixed and melted in the following proportions (unless otherwise specified)—

Proportions.

Asphalt	...	... 1 part.
Bitumen	...	... $\frac{1}{3}\frac{1}{2}$ „
Clean sharp sand	...	... $\frac{1}{2}$ „

will then be laid on smoothly and equally $\frac{1}{2}''$ (or $\frac{3}{4}''$ as specified) thick, and will be carefully and steadily rubbed with a hand float until the surface is perfectly even and true.

3. The junctions of the sections of the asphalting are to be carefully made, and before the surface becomes hard it is to be worked off perfectly level and smooth with fine clean sand, and to be left of a uniformly dark colour.

Finishing off.

LXV.—Bastard Asphalt Flooring.

1. This description of flooring will consist of a layer of road metal boiled in coal tar, the upper surface when spread and rolled being finished off with a coat of materials consisting of coarse gravel and slaked lime boiled in a mixture of pitch and coal tar, sanded, and finally rolled.

Description.

2. The formation having been properly levelled and thoroughly rolled, upon its surface will be spread, whilst hot, a six inch layer of materials consisting of *one inch cube* road metal well boiled in coal tar. The materials when spread to be thoroughly consolidated with an iron or stone roller, kept well wetted whilst in use.

First layer of materials.

Note.—The coal tar used should be of moderate consistency and well boiled ; if too liquid, it will prevent the proper adhesion of the materials when rolled.

3. On this a half inch coat of materials will be spread, consisting of

(1) Small stone chips or coarse gravel... 2 parts.
(2) Slaked lime ... ... 1 part.

boiled in a mixture of pitch and coal tar in the proportion of one of the former to two of the latter. This mixture will also be applied hot, and then carefully and evenly spread out.

Second layer of materials.

Note.—Pounded hard burnt brick, or kunker slags, may be substituted for the small stone chips or coarse gravel.

4. The surface thus formed to be then covered with a $\frac{1}{4}$ inch layer of very fine sharp sand, and finally rolled.

Finishing.

5. The work to be carried out in successive widths corresponding with the length of the roller to be used in its consolidation, so that the whole width may be evenly rolled as the roller passes over it each time. Battens, say 3″ × 6″ and about 9 feet in length, to be set on edge and secured in position along the outer or exposed edges of each width of flooring whilst the work is in progress, so as to confine the materials therein whilst the process of spreading and rolling is going on. On the completion of the first width they will be removed and again fixed in new positions to admit of a second width being laid, and so on. Care to be taken to well paint the last joint before adding a fresh width, in order to secure proper adhesion of the materials throughout.

Method of carrying out the work.

Note.—This description of flooring has been used on the G. I. P. Railway in goods' shed platforms, &c., and found to be durable, and answer well in all cases when not exposed to the action of the sun. In the floors of ordinary buildings its depth need not exceed 3 inches. Its cost per 100 superficial feet (even when 6 inches in thickness) is less than half that of the commonest description of stone paving (Specification No. LVIII.)

LXVI.—Minton's Tiles Floor.

1. Concrete bedding formed as per paras. 1 and 2 of Specification No. LXIII to be evenly covered with a coat of mortar, and truly levelled after an interval of two or three days.

Bedding.

2. The tiles to be carefully set in Portland Cement on surface thus prepared. For every 100 square feet of tiles not less than ¾ cask of cement should be used.

Setting in Cement.

3. The floors should be thoroughly washed within ten days of completion of each portion, and handed over clean.

Cleaning.

4. Pattern to be approved by Executive Engineer.

Pattern.

LXVII.—Wooden Flooring for Ground Floors.

1. The foundation to consist of two layers of concrete, each 3 inches deep, on which will be placed at 2 feet clear intervals, both along the length and breadth of the room, blocks of stone or brick masonry 9 inches square. On these blocks will rest flooring joists 4″ × 4″, which will support the planked flooring.

Description of foundation.

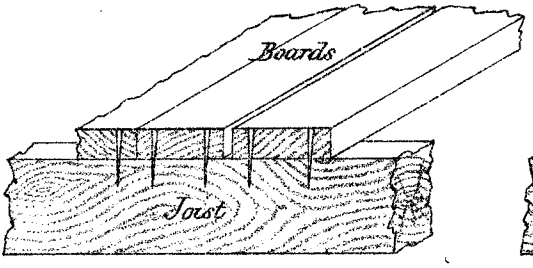
Joists.

2. The concrete to be prepared and laid in accordance with Specification No. LII. In ramming the concrete care to be taken by constant tests to ensure the required level being maintained, and the floor having an even surface.

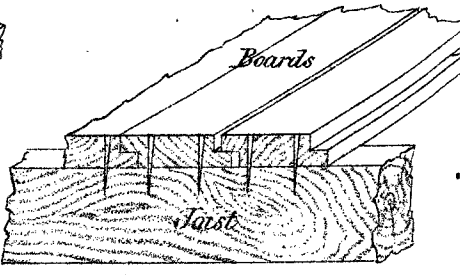
Concrete.

Different methods of laying Floor Boards.

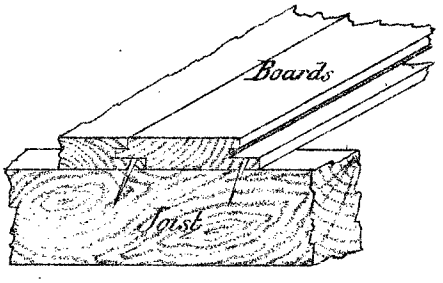
Plain Jointed



Rebated



Rebated, Tongued and Grooved



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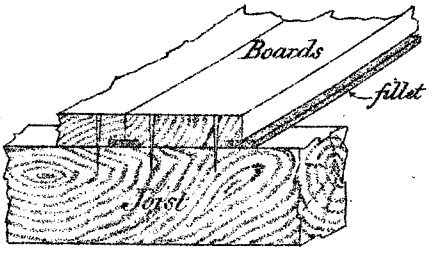
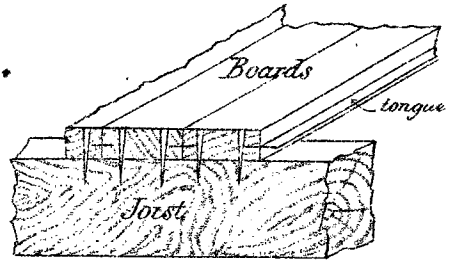
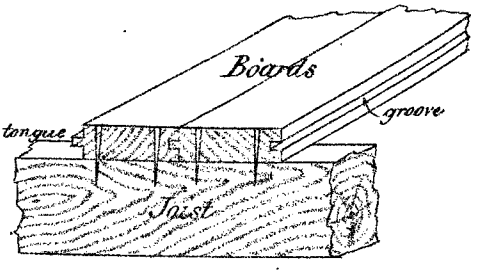


Tongued and Ploughed



Tongued and Grooved



Govt Photozincc Office, Poona, 1882

3. A sufficient number of air passages to be provided through the walls to admit of a free circulation of air under the planked floor; the outer mouths of these passages to be covered with strong iron wire netting of ¼ inch meshes.

Air passages.

4. The floor boarding to consist of teak planks 1½ inches thick and not more than 6 inches wide, tongued and grooved (or tongued and ploughed as may be specified), screwed to the joists below with screws 2½ inches long, their heads being countersunk into the planks, and the upper surface of the planks then planed smooth. The heading joints to be rebated and tongued, and to rest in all cases upon the bridging joists to which they will be secured by two screws, and to break joint with one another.

Floor boarding.

LXVIII.—Floor Planking.

1. To be of the best Moulmein Teak boards, thoroughly seasoned, and of the greatest length procurable.

Timber.

2. Boards to be 1½ inches thick, and from 4 to 6 inches in width.

Scantlings.

3. To be tongued and grooved, or tongued and ploughed, as may be specified in each instance.

Side joints.

4. Heading joints to rest upon the joists below, to break joint with one another, and to be rebated and tongued together.

Heading joints.

5. The boards to be jammed together as they are being laid by flooring cramps: each board to be secured in its proper position by two 2½ inch screws screwed to the bridging joists below.

Laying.

6. The heads of all screws to be countersunk, and the exposed surfaces then planked quite smooth.

Planing.

LXIX. and LXX.—Single Flooring.

1. To be constructed of the best Moulmein Teak Timber, well seasoned, free from sapwood, large or loose knots, shakes, or other imperfections.

Timber.

2. Bridging joists to be laid in all cases at central distances of 12 inches apart, and their ends to be nailed, cogged or notched on to the wall plates on which they rest. Their breadth may vary from 2 to 3 inches. The scantlings in each instance to be in accordance with

Bridging joists.

those given in the accompanying table. (See Table Nos. I and II.)

Strutting apart.

3. When the bridging joists exceed 10 feet in length they are to be strutted apart at intervals of about 6 feet by simple pieces of board one inch thick, fitted in between the joists at right angles to them and of their full depth.

Wall plates.

4. Wall plates to be laid flush with the inner face of the wall and to be in as long lengths as possible; when two or more pieces are required to extend along the length of the wall their ends to be carefully scarfed together. Their scantlings to be $4\frac{1}{2}'' \times 3''$

Floor planking.

5. Floor planking to be in accordance with Specification No. LXVIII. above.

Ventilation.

6. Care to be taken that a free circulation of air is allowed round the ends of the bridging joists and along the inner side of the wall plates to which they are secured.

LXXI and LXXII.—Double Flooring.

General.

1. Similar in all respects as regards timber, floor planking, bridging joists, &c., to Specification No. LXIX above.

Girders.

2. The bridging joists to be supported intermediately on girders placed at such central distances as may be specified from 6 to 10 feet, and to be of the scantling requisite in each case (see Table Nos. III and IV.)

Templates or corbels.

3. The ends of the girders to rest in the walls on stone or wooden templates not less than 2 to 4 feet in length, or on stone corbels built into the wall provided for that purpose.

Ventilation.

4. When laid on templates in the wall care to be taken to secure a free circulation of air round them.

Rise in centre.

5. All floors of the above description to be laid with a rise in the centre of $\frac{3}{4}$ inch in every 20 feet to allow for the subsequent settlement which is likely to take place.

PROBABLE COST OF EXECUTING WORK ACCORDING TO THE ABOVE SPECIFICATIONS.

LV.—Paving, 1st Sort.

On 6″ Concrete.

Artificers, Labourers, and Materials for 100 Supl. Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per.	Rs. a.
Stones, rough, 12½″ × 12½″ each ...Supl. ft.	106	0 2 foot.	13 4			
Lime, slaked ...C. F.	6	12 0 40 C. F.	1 12			
Sand ... ...C. F.	6	2 0 100 C. F.	0 2			
Charcoal... ... lbs.	80	1 0 80 lbs.	1 0			
Iron ... ... lbs.	6	1 0 8 lbs.	0 12			
Sundries	...	.....	0 8			
Labour .		Total Materials .	17 6			
Masons for dressing ...	25	0 12 each.	18 12			
Do. for setting ...	12	0 12 do.	9 0			
Coolies	6	0 3 do.	1 2			
Women	6	0 2 do.	0 12			
Smiths...	1½	0 12 do.	1 2			
Bellows-boys	1½	0 4 do.	0 6			
Bhisties	¼	0 8 do.	0 2			
Grinding chunam C. F.	6	4 0 100 C. F.	0 4			
Sundries	...	...	0 12			
		Total Labour...	32 4			
Add. Concrete... ...C. F.	50	18 0 100 C, F.	9 0			
Total for 100 Supl. Feet ...			58 10	Total for 100 Supl. Ft.		

LVI.—Paving, 2nd Sort.

On 6″ Concrete.

Artificers, Labourers and Materials for 100 Supl. Feet.	No. or quantity.	Rate.				Amount		No. or quantity.	Rate.			Amount	
		Rs.	a.	Per		Rs.	a.		Rs.	a.	Per	Rs.	a.
Materials.													
Stones, rough, $12\frac{1}{2}'' \times 12\frac{1}{2}''$ each Supl. ft.	106	0	2	foot.		13	4						
Lime, slaked ...C. F.	9	12	0	40	C. F.	2	11						
Sand ... ...C. F.	13	2	0	100	C. F.	0	4						
Charcoal... ... lbs.	60	1	0	80	lbs.	0	12						
Iron ... ... lbs.	4	1	0	8	lbs.	0	8						
Sundries	...			...		0	10						
		Total Materials.				18	1						
Labour.													
Masons, for dressing ...	12	0	12		each.	9	0						
Do. for setting ...	10	0	12		do.	7	8						
Coolies...	5	0	3		do.	0	15						
Women	5	0	2		do.	0	10						
Smiths...	1	0	12		do.	0	12						
Bellows-boys	1	0	4		do.	0	4						
Bhisties	$\frac{1}{4}$	0	8		do.	0	2						
Grinding chunam C. F.	13	3	0	100	C. F.	0	6						
Sundries	...			...		0	10						
		Total Labour...				20	3						
Add.													
Concrete ... C. F.	50	18	0	100	C. F.	9	0						
Total for 100 Supl. Feet ...						47	4	Total for 100 Sulp. Ft					

LVII.—Paving, 3rd Sort.

On 3" Concrete.

Artificers, Labourers, and Materials for 100 Supl. Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Stones, Supl. ft., rough, $12\frac{1}{2}'' \times 12\frac{1}{2}''$ each ...	100	0 $1\frac{1}{2}$ foot.	9 6			
Lime, slaked ...C. F.	12	12 0 40 C. F.	3 10			
Sand ... ...C. F.	18	2 0 100 C. F.	0 6			
Charcoal... ... lbs.	30	1 0 80 lbs.	0 6			
Iron ... ... lbs.	2	1 0 8 lbs.	0 4			
Sundries... ...	...	...	0 10			
		Total Materials.	14 10			
Labour.						
Masons	8	0 12 each.	6 0			
Do.	8	0 12 do.	6 0			
Coolies...	5	0 3 do.	0 15			
Women	5	0 2 do.	0 10			
Smiths	$\frac{1}{2}$	0 12 do.	0 6			
Bellows-boys	$\frac{1}{2}$	0 4 do.	0 2			
Bhisties	$\frac{1}{4}$	0 8 do.	0 2			
Grinding chunam C. F.	18	3 0 100 C. F.	0 9			
Sundries	...	...	0 10			
		Total Labour ...	15 6			
Add.						
Concrete ... C. F.	25	18 0 100 C. F.	4 8			
Total for 100 Supl. Feet ...			34 8	Total for 100 Supl. Ft.		

LVIII.—Paving, 4th Sort.

On 3″ Concrete.

Artificers, Labourers, and Materials for 100 Supl. Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Stones, rough, Supl. ft.	100	0 1 foot.	6 4			
Rest same as for paving 3rd class ...	...	...	5 4			
		Total Materials.	11 8			
Labour.						
Same as for paving, 3rd sort	...		15 6			
Add.						
Concrete ... C. F.	25	18. 0 100	4 8			
Total for 100 Supl. Feet ...			31 6	Total for 100 Supl. Ft.		

In the 3rd and 4th classes, the stones would not run more than 3″ to 4″ thick.

Note.—In buildings to be paved, the top of the plinth should be kept at least 6″ below floor-level; otherwise tops of stones of plinths have frequently to be knocked out, thereby damaging the masonry.

LIX.—Paving upper storey, 1st Sort.

Artificers, Labourers, and Materials for 100 Supl. Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Stone, rough, 1½′ × 1′ × 4′ Supl. Ft.	106	0 3 foot.	19 14			
Portland Cement, one barrel or C. F.	4	12 0 4 C. F.	12 0			
Charcoal ... lbs.	120	1 0 80 lbs.	1 8			
Iron ... ... lbs.	8	1 0 8 lbs.	1 0			
Sundries	...	.....	0 12			
		Total Materials.	35 2			
Labour.						
Masons for dressing ...	44	0 12 each.	33 0			
Do. for setting ...	8	0 12 do.	6 0			
Nowgunnies	4	0 5 do.	1 4			
Coolies	4	0 3 do.	0 12			
Women	4	0 2 do.	0 8			
Smiths	2	0 12 do.	1 8			
Bellows-boys	2	0 4 do.	0 8			
Bhisties	¼	0 8 do.	0 2			
Sundries	...	.....	0 12			
		Total Labour...	44 6			
Total for 100 Supl. Feet...			79 8	Total for 100 Supl. Ft.		

N.B.—Labour and materials for bedding are not included here.

LX.—Paving upper storey, 2nd Sort.

Artificers, Labourers, and Materials for 100 Supl. Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Stones, Supl. ft., rough 18″ × 12″ ×4″ ...	106	0 3 foot.	19 14			
1½ barrel Portland Cement, or ... C. F.	6	12 0 4 C. F.	18 0			
Charcoal ... lbs.	90	1 0 80 lbs.	1 2			
Iron ... ... lbs.	6	1 0 8 lbs.	0 12			
Sundries	...	.....	0 10			
		Total Materials.	40 6			
Labour.						
Masons for dressing ...	33	0 12 each,	24 12			
Do. for setting ...	6	0 12 do.	4 8			
Nowgunnies	4	0 5 do.	1 4			
Coolies	4	0 3 do.	0 12			
Women	4	0 2 do.	0 8			
Smiths	1½	0 12 do.	1 2			
Bellows-boys	1½	0 4 do.	0 6			
Bhisties	½	0 8 do.	0 4			
Sundries		.....	0 10			
		Total Labour...	34 2			
		Total for 100 Supl. Feet...	74 8		Total for 100 Supl. Ft.	

N.B.—Labour and materials for bedding are not included.

LXI.—Brick Floor laid flat.

On 6" Concrete.

Artificers, Labourers and Materials for 100 Supl. Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Bricks 9" × 4¼" × 2½" allowing 5 per cent. for wastage... ...	375	12 0 1,000	4 8			
Lime, slaked C. F.	4	12 0 40C.F.	1 3			
Sand... ... C. F.	6	2 0 100C.F.	0 2			
Sundries	...	.....	0 4			
		Total Materials.	6 1			
Labour.						
Bricklayers	5	0 10 each.	3 2			
Coolies for rubbing bricks	3	0 3 do.	0 9			
Women	3	0 2 do.	0 6			
Bhisties	½	0 8 do.	0 2			
Grinding chunam C. F.	6	3 0 100C.F.	0 3			
Sundries	...	.....	0 5			
		Total Labour...	4 11			
Add.						
Concrete ... C. F.	50	18 0 100	9 0			
		Total for 100 Supl. Feet...	19 12		Total for 100 Supl. Ft.	

LXII.—Brick Floor laid on edge.

On 6″ Concrete.

Artificers, Labourers, and Materials for 100 Supl. Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Bricks 9″ × 4½″ × 2½″ allowing 5 per cent. for wastage... ...	650	12 0 1,000	7 13			
Lime, slaked ... C. F.	6	12 0 40 C. F.	1 13			
Sand ... ... C. F.	9	2 0 100 C.F.	0 3			
Sundries	...	.....	0 4			
		Total Materials.	10 1			
Labour.						
Bricklayers	9	0 10 each.	5 10			
Coolies for rubbing bricks	5	0 3 do.	0 15			
Women	5	0 2 do.	0 10			
Bhisties	¼	0 8 do.	0 2			
Grinding chunam C. F.	9	3 0 100C.F.	0 4			
Sundries	...	.....	0 6			
		Total Labour...	7 15			
Concrete ... C. F.	50	18 0 100 C.F.	9 0			
Total for 100 Supl. Feet...			27 0	Total for 100 Supl. Ft.		

LXIII.—Chunam or Terraced Floor.

Artificers, Labourers and Materials for 100 Supl. Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Concrete 6″ thick C. F.	50	18 0 100 C.F.	9 0			
Plaster ¾″ thick, rough S. F.	100	4 10 100 S.F.	4 10			
Do. fine coat S. F.	100	2 13 do.	2 13			
		Total Materials,	16 7			
Extra Labour.						
Coolies for ramming concrete	5	0 3 each.	0 15			
Women for tapping plaster	6	0 2 do.	0 12			
Sundries, such as mussala, &c.	...	.....	0 12			
		Total Labour...	2 7			
Total for 100 Supl. Feet ...			18 14	Total for 100 Supl. Ft.		

LXIV.—Asphalt Flooring, ½″ thick.

On 6″ Concrete.

Artificers, Labourers and Materials for 100 Supl. Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Concrete 6″ thick, including extra labour of ramming ...C. F.	50	19 3 100 C.F.	9 10			
Asphalt... ... Cwt.	4	110 0 ton.	22 0			
Bitumen ... lbs.	14	17 0 Cwt.	2 2			
Sand, lbs. 224 or C. F.	2½	3 0 100 C.F.	0 1			
Firewood ... lbs.	320	1 0 320 lbs.	1 0			
Sundries	...	.....	0 8			
		Total Materials.	35 5			
Labour.						
Men for spreading. No.	4	0 10 each.	2 8			
Coolies...	4	0 3 do.	0 12			
Women	2	0 2 do.	0 4			
Conveyance of Asphalt, &c., up country, say	...	.....	5 0			
Sundries	...	.....	0 8			
		Total Labour...	9 0			
Total for 100 Supl. Feet ½″ thick Asphalt on 6″ of concrete bedding			44 5		Total for 100 Supl. Feet ½″ thick Asphalt on 6″ of concrete bedding ...	

N.B.—8 lbs. of Asphalt composition will cover 1 square foot ¾″ thick.—MOLESWORTH.

LXV.—Bastard Asphalt Flooring, 6″ thick.

Labour and Materials for 350 Supl. Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Coal Tar ... Casks.	2	11 0 cask.	22 0			
Pitch ... ... do.	½	12 8 do.	6 4			
Road Metal 1″... C.F.	175	6 0 100	10 8			
Lime ... ... C. F.	4	12 0 40	1 3			
Firewood ... lbs.	560	1 0 320	1 12			
Sundries	...	.....	1 0			
		Total Materials.	42 11			
Labour.						
Men for spreading. No.	2	0 12 each.	1 8			
Coolies... ... No.	24	0 3 do.	4 8			
Women ... No.	12	0 2 do.	1 8			
		Total Labour...	7 8			
		Total for 350 Supl. Feet ...	50 3			
		Or per 100 Supl. Feet...	14 5			

LXVI.—Minton's Tile Floor.

Artificers, Labourers, and Materials for 100 Supl. Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Minton tiles allowing 8 Supl. ft. for breakage ... Sq. Yds.	12	(In England.) 3 0 Sq. Yd.	36 0			
Portland Cement ¾ cask or ... C. F.	3	12 0 4 C.F.	9 0			
Lime, slaked ... C. F.	4	12 0 40 C.F.	1 3			
Sand ... ... C. F.	4	2 0 100 C.F.	0 1			
Sundries	...	... ...	1 4			
		Total Materials.	47 8			
Labour.						
Freight and landing, &c., say 50 per cent. of the cost	...	... ...	18 0			
Conveyance up country	...	... ...	5 0			
Bricklayers	14	0 12 each.	10 8			
Women	14	0 2 do.	1 12			
Sundries	...	... ...	1 4			
		Total Labour ...	36 8			
Add.						
Concrete 6" ...C. F.	50	19 3 100 C.F.	9 10			
Total for 100 Supl. ft. of Minton's Tile floor on 6" of concrete			93 10		Total for 100 Supl. ft. of Minton's Tile floor on 6" of concrete ...	

N.B.—The cost of ordinary Minton's Tiles in England varies from Rs. 3 to Rs. 6 per square yard.

LXVII.—Wooden Flooring for Ground Floors.

Artificers, Labourers, and Materials for 100 Supl. Feet.	No. or quantity.	Rate.	Amount.	No. or quantity.	Rate.	Amount.
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Teak Planking $1\frac{1}{2}''$, $5\frac{1}{2}''$ clear of tongue. R.F.	220	17 0 100	37 6			
Joists 4" × 4" ... C.F.	6	3 0 C.F.	18 0			
Screws $2\frac{1}{2}''$ ... doz.	8	1 8 Gross.	1 0			
Sundries	...	... ...	0 10			
		Total Materials.	57 0			
Labour.						
Carpenters	5	0 12 each.	3 12			
Coolies	5	0 3 do.	0 15			
Carriage	...	... ...	3 12			
Sundries	...	... ...	0 9			
		Total Labour.	9 0			
Add.						
Concrete 6" including blocks for joists. C.F.	50	20 0 100	10 0			
		Total for 100 Supl. Feet...	76 0			

LXVIII.—Floor Planking.

Artificers, Labourers, and Materials for 100 Supl. Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Teak planking $1\frac{1}{2}''$, $5\frac{1}{2}''$ clear of tongue R. F.	220	17 0 100 R.F.	37 6			
Screws $2\frac{1}{2}''$ Doz.	8	1 8 Gross	1 0			
Sundries	...	... ...	0 8			
		Total Materials.	38 14			
Labour.						
Carpenters	3	0 12 each.	2 4			
Coolies	3	0 3 do.	0 9			
Sundries	...	... .	0 5			
Carriage	...	... ...	3 0			
		Total Labour...	6 2			
		Total for 100 Supl. Feet...	45 0		Total for 100 Supl. Ft.	

Girders and Joists.

(1) May be taken as wrought timber, and annas six (6) per C. F. is a fair rate for labour including fixing in place, &c.

(2) For rate for floors, including girders and joists, see Nos. LXIX and LXXI.

LXIX.—Single Flooring.

Weight supported 140 *lbs. per sq. foot.*

SPAN IN FEET.	Area supported.	Joists 12″ apart.					Wall Plates.					Total C. F. Joists and Wall Plates.	RATE.	Total Cost of Joists and Wall Plates.	Floor Plank at Rs. 45 per 100.	Total Cost of Area in Col. II.	Rate per 100 sq. ft.
		No.	L′	B″	D″	C. F.	No.	L′	B″	D″	C.F.			Rs. a.	Rs.	Rs. a.	Rs. a.
VI ..	60	10	7	2½	4	4·86						6·73	Rs. 3 annas 12 per C. Ft., which includes fixing in place, cost of carriage, &c., &c.	25 4	27	52 4	87 1
VIII ..	80	10	9	2½	5½	8·59						10·46		39 4	36	75 4	94 1
X ..	100	10	11	2½	6¾	12·89						14·76		55 6	45	100 6	100 6
XII ..	120	10	13	2½	8	18·05	2	10	4½	3	1·87	19·92		74 11	54	128 11	107 4
XIV ..	140	10	15	2½	9½	24·74						26·61		99 12	63	162 12	116 4
XVI ..	160	10	17	2½	11	32·46						34·33		128 12	72	200 12	125 8
XVIII ..	180	10	19	2½	12¼	40·40						42 27		158 8	81	239 8	133 1
XX ..	200	10	21	2½	13½	49·21						51·08		191 9	90	281 9	140 12

Note.—For scantlings of Joists varying from 2 to 3 inches in breadth see Table I.

LXX.—Single Flooring.

Weight supported 168 *lbs. per sq. foot.*

SPAN IN FEET.	Area supported.	Joists 12″ apart.					Wall Plates.					Total C. F. Joists and Wall Plates.	RATE.	Total Cost of Joists and Wall Plates.	Floor Plank at Rs. 45 per 100.	Total Cost of Area in Col. II.	Rate per 100 sq. ft.
		No.	L′	B″	D″	C. F.	No.	L″	B″	D″	C.F.			Rs. a.	Rs.	Rs. a.	Rs. a.
VI ..	60	10	7	2½	4½	5·16						7·03	Rs. 3 annas 12 per C. Ft., which includes fixing in place, cost of carriage, &c., &c.	26 6	27	53 6	88 15
VIII ..	80	10	9	2½	5¾	8·98						10·85		40 11	36	76 11	95 14
X ..	100	10	11	2½	7½	13·83						15·70		58 14	45	103 14	103 14
XII ..	120	10	13	2½	8½	19·18	2	10	4½	3	1·87	21·05		78 15	54	132 15	110 13
XIV ..	140	10	15	2½	10	26·04						27·91		104 11	63	167 11	119 12
XVI ..	160	10	17	2½	11½	33·94						35·81		134 4	72	206 4	128 15
XVIII ..	180	10	19	2½	13	42·88						44·75		167 13	81	248 13	138 4
XX ..	200	10	21	2½	14½	52·86						54·73		205 4	90	295 4	147 10

Note.—For scantlings of Joists varying from 2 to 3 inches in breadth see Table II.

LXXI.—Double Flooring.

Weight supported 140 *lbs. per sq. foot.*

SPAN IN FEET.	Distance apart of Girders.	Area supported.	Girders 6′, 8′, and 10′ apart.					Joists 12″ apart.					Total C. F. Girders and Joists.	RATE.	Total Cost of Girders and Joists.	Floor Plank at Rs. 45.	Total Cost of Area in Col. III.	Rate per 100 S. F.
			No.	L′	B″	D″	C.F.	No′	L′	B″	D″	C. F.			Rs. a.	Rs. a.	Rs. a.	Rs. a.
XII	6	72	1	13½	6½	11½	6·85	13	6	2½	4	5·41	12·26	Rupees 3 annas 12 per C. F., which includes fixing in place, cost of carriage, &c. &c.	46 0	32 6	78 6	108 14
	8	96			7	12	7·87		8	2½	5½	9·92	17·79		66 11	43 3	109 14	114 7
	10	120			7½	12⅜	8·66		10	2½	6¾	15·23	23·89		89 9	54 0	143 9	119 10
XIV	6	84	1	15½	7¼	12½	9·75	15	6	2½	4	6·25	16·00		60 0	37 13	97 13	116 7
	8	112			7½	13⅜	11·26		8	2½	5½	11·45	22 71		85 3	50 6	135 9	121 1
	10	140			8¼	14¼	12·65		10	2½	6¾	17·57	30·22		113 5	63 0	176 5	125 15
XVI	6	96	1	17½	8	14	13·61	17	6	2½	4	7·08	20·69		77 9	43 3	120 12	125 12
	8	128			8½	15	15·49		8	2½	5½	12·98	28 47		106 12	57 10	164 6	128 7
	10	160			9	15⅜	17·22		10	2½	6¾	19·92	37·14		139 4	72 0	211 4	132 0
XVIII	6	108	1	20	8¾	15½	18·53	19	6	2½	4¼	7·91	26·44		99 2	48 10	147 12	136 13
	8	144			9½	16¼	21·44		8	2½	5½	14·51	35·95		134 13	64 13	199 10	138 10
	10	180			10	17⅛	23·95		10	2½	6¾	22·26	46·21		173 4	81 0	254 4	141 4
XX	6	120	1	22	9½	16½	23·94	21	6	2½	4	8·75	32·69		122 9	54 0	176 9	147 2
	8	160			10¼	17⅜	27·79		8	2½	5½	16·04	43·83		164 6	72 0	236 6	147 12
	10	200			10¾	18¼	30 79		10	2½	6¾	24·61	55·40		207 12	90 0	297 12	148 14
XXII	6	132	1	24	10½	17¾	30·32	23	6	2½	4	9·58	39·90		149 10	59 6	209 0	158 5
	8	176			11	19	34·83		8	2½	5½	17·56	52·39		196 7	79 3	275 10	156 10
	10	220			11½	20	38·33		10	2½	6¾	26·95	65·28		244 13	99 0	343 13	156 4

Note.—For scantlings of Girders placed at central distances apart other than the above see Table III.

LXXII.—Double Flooring.

Weight supported 168 *lbs. per sq. foot.*

SPAN IN FEET.	Distance apart of Girders.	Area supported.	Girders 6′, 8′, and 10′ apart.					Joists 12″ apart.					Total C. F. Girders and Joists.	RATE.	Total Cost of Girders and Joists.	Floor Plank at Rs. 45.	Total Cost of Area in Col. III.	Rate per 100 S. F.
			No.	L′	B″	D″	C. F.	No.	L′	B″	D″	C.F.			Rs. a.	Rs. a.	Rs. a.	Rs. a.
XII	6	72	1	13½	6⅜	11⅜	7·43	13	6	2½	4½	5·75	13·18	Rupees 3 annas 12 per C. F., which includes fixing in place, cost of carriage, &c. &c.	49 7	82 6	81 13	113 10
	8	96			7½	12½	8·49		8	2½	5½	10·37	18·86		70 12	43 3	113 15	118 11
	10	120			7½	13½	9·62		10	2½	7½	16·36	25·98		97 7	54 0	151 7	126 3
XIV	6	84	1	15½	7½	13½	10·69	15	6	2½	4½	6·64	17·33		65 0	37 13	102 13	122 6
	8	112			8½	14½	12·65		8	2½	5½	11·97	24·62		92 5	50 6	142 11	127 6
	10	140			8½	15	13·72		10	2½	7½	18·88	32·60		122 4	63 0	185 4	132 5
XVI	6	96	1	17½	8½	14½	14·97	17	6	2½	4½	7·52	22·49		84 5	43 3	127 8	132 13
	8	128			9	15½	16·95		8	2½	5½	13·57	30·52		114 7	57 10	172 1	134 7
	10	160			9½	16½	19·05		10	2½	7½	21·39	40·44		151 10	72 0	223 10	139 12
XVIII	6	108	1	20	9½	16	20·55	19	6	2½	4½	8·41	28·96		108 10	48 10	157 4	145 10
	8	144			9½	17	23·02		8	2½	5½	15·17	38·19		143 3	64 13	208 0	144 7
	10	180			10½	18	26·25		10	2½	7½	23·91	50·16		188 2	81 0	269 2	149 8
XX	6	120	1	22	10	17½	26·85	21	6	2½	4½	9·29	35·64		133 10	54 0	187 10	156 6
	8	160			10½	18½	30·38		8	2½	5½	16·77	47·15		176 13	72 0	248 13	155 8
	10	200			11¼	19½	33·51		10	2½	7½	26·43	59·94		224 12	90 0	314 12	157 6
XXII	6	132	1	24	10¾	18⅞	33·14	23	6	2½	4½	10·18	43·32		162 7	59 6	221 13	168 1
	8	176			11½	19¾	37·85		8	2½	5½	18·36	56·21		210 12	79 3	289 15	164 12
	10	220			12	21	42·00		10	1½	7½	28·94	70·94		266 0	99 0	365 0	165 15

Note.—For scantlings of Girders placed at central distances apart other than the above, see Table IV.

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V.—DOOR AND WINDOW SPECIFICATIONS.

LXXIII.—Door and Window Frames.

1. To be of Moulmein teak, of the scantlings shown in the drawings, or as specified in Tables V to VII. (Wood.)

2. To be properly framed and morticed together, and to be set solidly in the masonry, the parts hidden by masonry to be tarred with boiling coal tar. (Fixing.)

3. To be rebated one side ½″ wide and full thickness of shutter, and to have a return bead moulded on the other side, or chamfered as may be directed. (Moulding.)

4. To be paid for by actual cubic content; curved frames for fanlights to be included in this item. (How paid for.)

Note.—Curved frames are usually paid for at double the rate for straight work.

DOORS.

LXXIV.—Doors, Panelled, 1st Class.

1. Door to be "hung folding" to be of 6 equal panels, 3 panels in height, and 2 in breadth. (Description.)

2. Frame to be as in Specification No. LXXIII above. (Frame.)

3. The styles, top, bottom, lock and frieze rails to be moulded on both sides with ovals and fillet moulding (unless otherwise specified). (Styles and rails.)

4. The panels to be raised, feather-tongued into styles and rails, with beaded edges on both sides. The corners of the raised portion of the panels to be rounded off as shown in the drawings. (Panels.)

5. Each leaf to be hung with brass butt (or back flap) hinges fixed with brass screws and furnished with brass mortice lock with patent handles, brass flush bolts, and brass hooks with brass eyes in frame to keep the shutters open. (Furniture.)

6. Unless otherwise specified, the several parts to be of the dimensions stated in the tables to be found in another part of this book. (Table V.) (Dimensions.)

LXXV.—Doors, Panelled, 2nd Class.

1. To be similar in all respects, except the following, to Specification No. LXXIV above. (Description.)

2. Styles and rails to be chamfered on both sides instead of moulded, and the raised panels to have square corners and edges on both sides.

Styles, rails and panels.

LXXVI.—Doors, Panelled and Glazed, 1st Class.

1. To be similar in all respects, except the following, to Specification No. LXXIV above. The four upper panels to be glazed instead of panelled. The styles and rails to be rebated ½″ wide on the inside to receive glass instead of being moulded.

Description.

2. Sash bars to be moulded and mitred on the outside, and rebated ½″ wide on the inside to receive glass.

Sash bars.

3. Glazing to be of best English crown glass 21 oz. Each pane will be cut to fit the rebates truly, and secured with iron sprigs and putty in the usual manner.

Glazing.

LXXVII.—Doors, Panelled and Glazed, 2nd Class.

1. Same as above, but chamfered edges to styles, rails, &c., and raised panels to have square edges and corners.

Description.

2. Furniture to be of iron throughout instead of brass, with the exception of the lock, which will be as above.

Furniture.

LXXVIII.—Doors, Ledged.

1. To consist of framed vertical boards connected together by two or three pairs of horizontal ledges nailed across the back of the door.

Description.

2. The boards to be planed, tongued and grooved, or rebated together as may be specified. One edge of each board to be beaded on the outside.

Boards.

3. Door to be "hung folding" when its width exceeds 3 feet.

Hung folding.

4. Edges and ends of ledges to be chamfered.

Ledges.

5. Each leaf to be hung with iron cross garnet or strap hinges screwed to the ledges, or with strong iron butt hinges as may be specified. To be provided with iron bolts, hooks and eyes, and an alldrop bolt and padlock.

Furniture.

6. Unless otherwise specified, the several parts to be of the dimensions shown in the tables (Table VI.)

Dimensions.

Door Panelled

Outside Inside

Style

Top rail

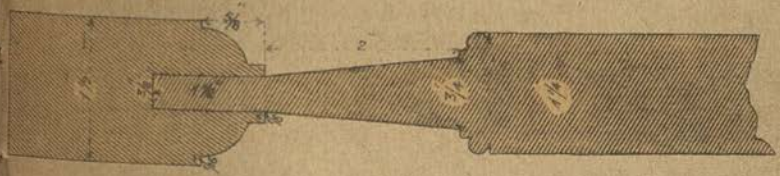
Frieze rail

Lock rail

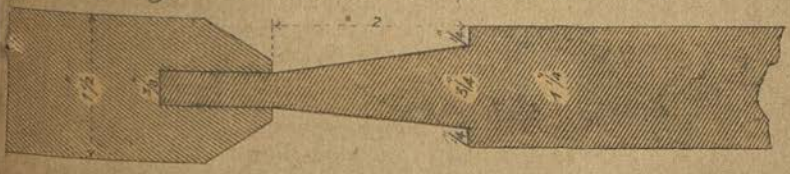
Bottom rail

Door Panelled & Glazed

Outside Inside

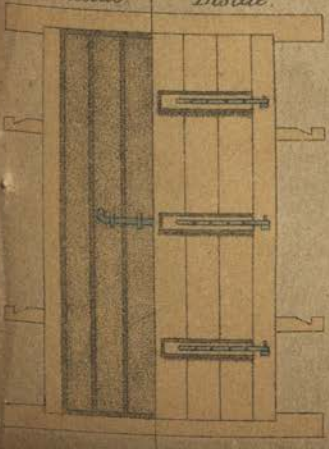


Horizontal Sections of Panelled Doors

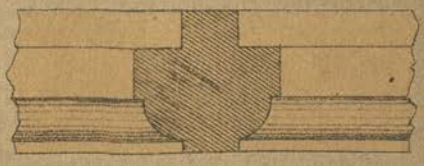


Planked or Ledged Door

Outside Inside



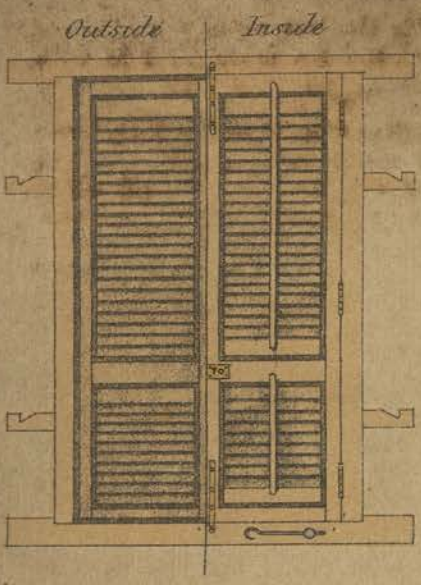
Section of Sash-bar



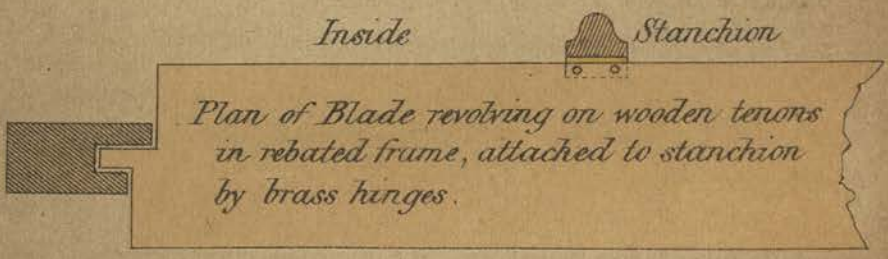
Horizontal Section of Ledged Door

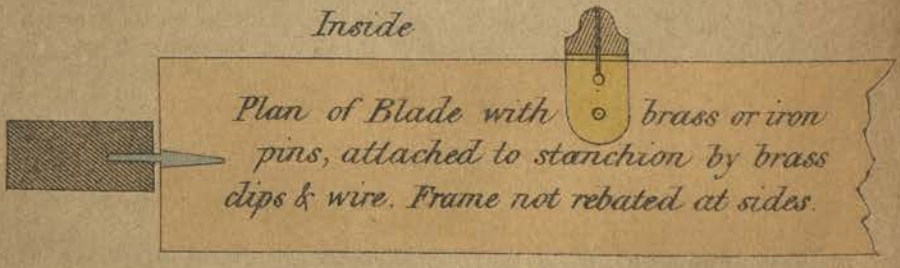
Photozincographed Ord. Office, Pesth 1872

Door Venetianed



Outside
Stanchion
Section through Venetians showing straight rebate in side of frame.
Outside
Section showing rebate in side of frame to fit Venetian





Photolithographed Ord. Office Feb. 1881

LXXIX.—Doors, Iron barred, with Plank Shutters.

Description. 1. Double shutters, outer pair of shutters planked, and the inner filled in with round iron bars.

Frame. 2. Frame to measure not less than 6″ × 4½″, and to be rebated ½″ wide all round on both sides and full thickness of the shutters. In all other respects to be similar to Specification No. LXXIII.

Plank shutter. 3. To be in accordance with Specification No. LXXVIII (see "Doors Ledged"), but to be hung with 3 pairs strong iron back flap hinges so that they may open back against the wall.

Iron barred shutters. 4. Styles, top, bottom, and lock rails to be 2½″ thick, framed together and filled in with round iron bars ¾ to 1 inch in diameter fixed at 4 inches central distances apart. The bars to be housed into the top and bottom rails to a depth of one inch, and to be passed through the lock rail. To be hung with 3 pairs strong iron butt hinges.

Furniture. 5. Iron bolts, hooks and eyes, and an alldrop bolt and padlock to be provided for each pair of shutters.

LXXX.—Doors, Venetianed, 1st Class.

Description. 1. Shall be the same in all respects as Specification No. LXXIV, except that the panels (of which there will be 4 only) will be filled in with venetians.

Blades. 2. The blades to be 3½″ wide and ⅜″ thick, and to overlap about half their width. To be secured to the moulded stanchion by brass hinges 1″ wide, and to have rounded edges.

Frame. 3. The frame of each shutter to be rebated all round *outside* on sides and bottom rail, and *inside* on top rail—ends of blades to be rounded off in centre to ⅜″ diameter and ¾″ long, and round holes to be made in the sides of the rebated portion of the frame to receive them.

LXXXI.—Doors, Venetianed, 2nd Class.

Description. 1. Same as above, except that the blades of the venetians will be attached to the moulded stanchions by clips of wire instead of brass hinges.

Furniture. 2. Furniture to be iron throughout as in Specification No. LXXX above, with the exception of the lock, which will be as above.

WINDOWS.

LXXXII.—Windows, Glazed, 1st Class.

Frame. 1. Frame to be as in Specification No. LXXIII.

Shutters. 2. To open in two shutters.

Styles and rails. 3. Styles top and bottom rails to be moulded on one side, and rebated ½″ on the other to receive the glass.

Sash bars. 4. Sash bars to be moulded and mitred on one side and rebated ½″ deep on other to receive glass.

Furniture. 5. Brass butt hinges, brass bolts, handles, and hooks and eyes to be provided.

Dimensions. 6. Unless otherwise specified, the several parts to be of the dimensions stated in the tables to be found in another part of this book. (Table VII.)

LXXXIII.—Windows, Glazed, 2nd Class.

Description. 1. To be similar in all respects to the above, except that styles and rails will be chamfered instead of moulded.

Furniture. 2. To be of iron instead of brass.

LXXXIV.—Windows, Plank Shutters.

1. To be similar in all respects to Specification No. LXXVIII above.

2. Furniture, iron.

LXXXV.—Windows, Iron barred with Plank Shutters.

Description. 1. Similar in all respects to the above, with the addition only that round iron bars ¾ inch in diameter will be passed through a centre rail, and fixed vertically at 3 inches central distance apart into the head and sill of the window frame.

LXXXVI.—Windows, Glass and Venetian Shutters, 1st Class.

Description. 1. Double shutters—outer pair of shutters venetianed and the inner glazed.

Frame. 2. Frame to be rebated ½″ wide all round on both sides and full thickness of shutters.

Venetian shutters. 3. Blades, frame &c., to be in accordance with Specification No. LXXX.

Glass shutters. 4. Glazed shutters to be similar in all respects to Specification No. LXXXII.

LXXXVII.—Windows, Glass and Venetian Shutters, 2nd Class.

1. To be similar in all respects to the above, except that the blades of the venetians will be attached to the moulded stanchions by clips of wire instead of by brass hinges, and the styles and rails of the glazed shutters will be chamfered instead of moulded.

Description.

2. Furniture, iron.

LXXXVIII—.Windows, Glazed, Barred and Shutters.

1. The glazed shutters to be fixed on the inside plank shutters outside with iron let into the frame of the window between the two.

Description.

Glazed shutters. 2. Glazed shutters to be as in Specification No. LXXXIII above.

3. Iron bars and plank shutters to be in all respects as in Specification No. LXXXV above, but without a centre rail.

Bars and plank shutters.

PROBABLE COST OF EXECUTING WORKS ACCORDING TO THE ABOVE SPECIFICATIONS.

LXXIV.—Doors, Panelled, 1st Class.

$4' \times 7' \times 1\frac{1}{2}''$.

Labour and Materials for 28 Square Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Teakwood ...C. F.	7·32	3 0 C. F.	21 15			
Butt hinges, brass, 4″ ... ...pairs.	3	16 4 doz. pairs.	4 1			
Mortice lock, brass ... ... No.	1	4 0 each.	4 0			
Bolts flush, brass, 10″ ... ... No.	2	13 0 dozen.	2 3			
Bolts flush, brass, 8″ ... ... No.	1	10 0 do.	0 13			
Hooks, brass ... No.	2	0 8 each.	1 0			
Sundries	...	...	0 8			
		Total Materials.	34 8			
Labour.						
On frames ...C. F.	3·25	0 5 C. F.	1 0			
On shutters ...S. F.	28	0 5 S. F.	8 12			
		Total Labour...	9 12			
		Total for 28 Square Feet ...	44 4			
		Or per Square Foot...Rs.	1 9			

LXXV.—Doors, Panelled, 2nd Class.

4′ × 7′ × 1½″.

Labour and Materials for 28 Square Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Teakwood ...C. F.	7·32	3 0 C. F.	21 15			
Butt hinges, iron, 4″ ... ...pairs.	3	5 12 doz. pairs.	1 7			
Mortice lock, brass ... ... No.	1	4 0 each	4 0			
Bolts, iron, 10″... No.	2	8 0 dozen	1 5			
Do. 8″ ... No.	1	6 0 do.	0 8			
Hooks, iron ... No.	2	0 2 each.	0 4			
Sundries	...	...	0 6			
		Total Materials.	29 13			
Labour.						
On frames ...C. F.	3·25	0 5 C. F.	1 0			
On shutters ...S. F.	28	0 4½ S. F.	7 14			
		Total Labour...	8 14			
		Total for 28 Square Feet ...	38 11			
		Or per Square Foot...Rs.	1 6			

LXXVI.—Doors, Panelled and Glazed, 1st Class.

4′ × 7′ × 1½″.

Labour and Materials for 28 Square Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Teakwood ....C F.	6·25	3 0 C. F.	18 12			
Butt hinges, brass, 4″ ... ...pairs.	3	16 4 doz. pairs.	4 1			
Mortice lock, brass No.	1	4 0 each.	4 0			
Bolts flush, brass, 10″ ... ... No.	2	13 0 dozen.	2 3			
Bolts flush, brass, 8″ ... ... No.	1	10 0 do.	0 13			
Hooks, brass ... No.	2	0 8 each.	1 0			
Panes of glass ... No.	16	0 4 do.	4 0			
Sundries		...	0 8			
		Total Materials.	35 5			
Labour.						
On frames ...C. F.	3·25	0 5 C.F.	1 0			
On shutters ...S. F.	28	0 5 S.F.	8 12			
		Total Labour...	9 12			
		Total for 28 Square Feet ...	45 1			
Or per Square Foot...Rs.			1 10			

LXXVII.—Doors, Panelled and Glazed, 2nd Class.

$4' \times 7' \times 1\frac{1}{2}''$.

Labour and Materials for 28 Square Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Teakwood ...C. F.	6·25	3 0 C. F.	18 12			
Butt hinges, iron, 4" ... ...pairs	3	5 12 doz. pairs	1 7			
Mortice lock, brass. No.	1	4 0 each.	4 0			
Bolts, iron, 10" ... No.	2	8 0 dozen.	1 5			
Do. do. 8" ... No.	1	6 0 do.	0 8			
Hooks, iron ... No.	2	0 2 each.	0 4			
Panes of glass ... No.	16	0 4 do.	4 0			
Sundries	...	.....	0 6			
		Total Materials.	30 10			
Labour.						
On frames ...C. F.	3·25	0 5 C. F.	1 0			
On shutters ...S. F.	28	0 4½ S. F.	7 14			
		Total Labour ...	8 14			
Total for	28	Square Feet...	39 8			
		Or per Square Foot ...Rs.	1 7			

LXXVIII.—Doors, Ledged.

$4' \times 7' \times 1\frac{1}{2}''$.

Labour and Materials for 28 Square Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Teakwood ... C.F.	8	3 0 C.F.	24 0			
Butt hinges, iron, 4″ ... ...pairs	3	5 12 doz. pairs	1 7			
Bolts, iron, 10″ ... No.	1	8 0 dozen.	0 11			
Do. do. 8″ ... No.	1	6 0 do.	0 8			
Handles, iron ... No.	1	0 4 each.	0 4			
Hooks, iron ... No.	2	0 2 do.	0 4			
All drop bolts ... No.	1	1 0 do.	1 0			
Sundries	...	.....	0 8			
		Total Materials.	28 10			
Labour.						
On frames ... C.F.	3·25	0 5 C.F.	1 0			
On shutters ... S.F.	28	0 1½ S.F.	2 10			
		Total Labour ...	3 10			
Total for	28	Square Feet...	32 4			
		Or per Square Foot ...Rs.	1 2			

LXXIX.—Doors, Iron barred with Plank Shutters.

$4' \times 7' \times 1\frac{1}{2}''$.

Labour and Materials for 28 Square Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Teakwood ...C. F.	13·5	3 0 C.F.	40 8			
Butt hinges, iron, 4″ ... ...pairs	3	5 12 doz.pairs	1 7			
Back flap, iron, 4″.pairs	3	1 4 pair.	3 12			
Bolts, iron, 10″ ... No.	4	8 0 dozen.	2 11			
Do. do. 8″ ... No.	2	6 0 do.	1 0			
Hooks, iron ... No.	4	0 2 each.	0 8			
All drop bolts ... No.	2	1 0 do.	2 0			
Iron, round, 1″ ... lbs.	105	0 1 lbs.	6 9			
Sundries	...	.....	1 0			
		Total Materials.	59 7			
Labour.						
On frames ...C. F.	4·87	0 5 C. F.	1 8			
On outer shutters .S. F.	28	0 1½ S.F.	2 10			
On inner do. S. F.	28	0 4 S.F.	7 0			
		Total Labour ...	11 2			
Total for	28	Square Feet...	70 9			
		Or per Square Foot ...Rs.	2 8			

LXXX.—Doors, Venetianed, 1st Class.

$4' \times 7' \times 1\frac{1}{2}''$

Labour and Materials for 28 Square Feet.	No. or quantity.	Rate.			Amount		No. or quantity.	Rate.			Amount	
Materials.		Rs.	a.	Per	Rs.	a.		Rs.	a.	Per	Rs.	a.
Teakwood ... C.F.	6·50	3	0	C. F.	19	8						
Hinges back flap, brass, 4″ ... ... pairs	3	4	0	pair.	12	0						
Boltsflush, brass, 10″No.	2	13	0	dozen.	2	3						
Do. do. 8″ No.	2	10	0	do.	1	10						
Handle, brass ... No.	1	0	8	each.	0	8						
Hooks, brass ... No.	2	0	8	do.	1	0						
Hinges, brass, for venetians ...dozen pairs	3	3	0	doz.pairs	9	0						
Mortice lock, brass, No.	1	4	0	each.	4	0						
Sundries	...	... ..			0	10						
		Total Materials.			50	7						
Labour.												
On frames ...C. F.	3·25	0	5	C. F.	1	0						
On shutters ...S. F.	28	0	6	S. F.	10	8						
		Total Labour ...			11	8						
Total for	28	Square Feet...			61	15						
Or per Square Foot ...Rs.					2	3						

LXXXI.—Doors, Venetianed, 2nd Class.

$4' \times 7' \times 1\frac{1}{2}''$.

Labour and Materials for 28 Square Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Teakwood ... C.F.	6·50	3 0 C.F.	19 8			
Hinges back flap, iron, 4″ ... ...pairs	3	1 4 pair.	3 12			
Bolts, iron, 10″ ... No.	2	8 0 dozen.	1 5			
Do. do. 8″ ... No.	2	6 0 do.	1 0			
Handle, iron ... No.	1	0 4 each.	0 4			
Hooks, iron ... No.	2	0 2 do.	0 4			
Clips, and wire for fastening blades ...	...	.....	3 0			
Mortice lock, brass, No.	1	4 0 each.	4 0			
Sundries	...	.....	0 9			
		Total Materials.	33 10			
Labour.						
On frames ...C. F.	3.25	0 5 C. F.	1 0			
On shutters ...S.F.	28	0 6 S. F.	10 8			
		Total Labour ...	11 8			
Total for	28	Square Feet ...	45 2			
		Or per Square Foot ...Rs.	1 10			

80027

LXXXII.—Windows, Glazed, 1st Class.

$4' \times 5' \times 1\frac{1}{4}''$.

Labour and Materials for 20 Square Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Teakwood ...C. F.	3·75	3 0 C.F.	11 4			
Glass, panes of, 11″ × 9″ No.	20	0 4 each.	5 0			
Butt hinges, brass, 4″ pairs.	2	16 4 doz. pairs	2 11			
Bolts flush, brass, 8″ No.	1	10 0 dozen.	0 13			
Do. do. 6″ No.	2	6 0 do.	1 0			
Handles, brass ... No.	2	0 8 each.	1 0			
Hooks, brass ... No.	2	0 8 do.	1 0			
Sundries		.....	0 8			
		Total Materials.	23 4			
Labour.						
On frames ...C. F.	2·15	0 5 C. F.	0 11			
On shutters ...S. F.	20	0 4 S.F.	5 0			
		Total Labour ...	5 11			
Total for	28	Square Feet ...	28 15			
Or per Square Foot ...Rs.			1 7			

LXXXIII—Windows, Glazed, 2nd Class.

$4' \times 5' \times 1\frac{1}{4}''$.

Labour and Materials for 20 Square Feet	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Teakwood ... C.F.	3·75	3 0 C. F.	11 4			
Glass, panes of. 11″ × 9″ No.	20	0 4 each.	5 0			
Butt hinges, iron, 4″. pairs	2	5 12 doz. pairs.	0 15			
Bolts, iron, 8″ ... No.	1	6 0 dozen.	0 8			
Do. do., 6″ ... No.	2	4 0 do.	0 11			
Handles, iron ... No.	2	0 4 each.	0 8			
Hooks, iron ... No.	2	0 2 do.	0 4			
Sundries	...	.....	0 5			
		Total Materials.	19 7			
Labour.						
On frames ... C.F.	2·15	0 5 C.F.	0 11			
On shutters ... S.F.	20	0 3½ S.F.	4 6			
		Total Labour...	5 1			
Total for	20	Square Feet ...	24 8			
Or per Square Foot ...Rs.			1 4			

LXXXIV—Windows, Plank Shutters.

$3' \times 4' \times 1''$.

Labour and Materials for 12 Square Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Teakwood ... C.F.	3	3 0 C.F.	9 0			
Butt hinges, iron, $3\frac{1}{2}''$ pairs.	2	4 12 doz. pairs	0 13			
Bolts, iron, 8" ... No.	1	6 0 dozen.	0 8			
Do. do. 6" ... No.	2	4 0 do.	0 11			
Handles, iron ... No.	2	0 4 each.	0 8			
Hooks, iron ... No.	2	0 2 do.	0 4			
Sundries...	...	.....	0 5			
		Total Materials.	12 1			
Labour.						
On frames ... C.F.	1·31	0 5 C.F.	0 7			
On shutters ... S. F.	12	0 $1\frac{1}{2}$ S.F.	1 2			
		Total Labour...	1 9			
Total for	12	Square Feet ...	13 10			
		Or per Square Foot...Rs.	1 2			

LXXXV.—Windows, Iron barred with Plank Shutters, 3′×4′×1″.

Labour and Materials for 12 Square Feet.	No. or quantity.	Rate.	Amount.	No. or quantity.	Rate.	Amount.
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Teakwood ... C. F.	3	3 0 C. F.	9 0			
Butt hinges, iron, 3½″ pairs	2	4 12 doz. pairs	0 13			
Bolts, iron, 8″ ... No.	1	6 0 dozen	0 8			
Do. do. 6″ ... No.	2	4 0 do.	0 11			
Handles, iron ... No.	2	0 4 each	0 8			
Hooks, iron ... No.	2	0 2 do.	0 4			
Iron, round, ¾″ ... lbs.	68	0 1 lbs.	4 4			
Sundries	...		0 5			
		Total Materials.	16 5			
Labour.						
On frames ... C.F.	1·31	0 5 C. F.	0 7			
On shutters ... S.F.	12	0 1½ S. F.	1 2			
On fixing iron bars S.F.	12	0 1 S. F.	0 12			
		Total Labour...	2 5			
Total for	12	Square Feet ...	18 10			
Or per Square Foot ... Rs.			1 9			

LXXXVI.—Windows, Glass and Venetian Shutters, 1st Class.

$4' \times 5' \times 1\frac{1}{4}''$.

Labour and Materials for 20 Square Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount.
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Teakwood ... C.F.	5	3 0 C.F.	15 0			
Glass, panes of, $11'' \times 9''$ No.	20	0 4 each	5 0			
Butt hinges, brass, 4" pairs	2	16 4 doz. pairs	2 11			
Back flap do. do. 4" pairs.	2	4 0 pair	8 0			
Bolts, flush, brass, 8" No.	2	10 0 dozen	1 11			
Do. do. 6" No.	4	6 0 do.	2 0			
Handles, brass ..No.	4	0 8 each	2 0			
Hooks, brass ...No.	4	0 8 do.	2 0			
Hinges, brass, for venetians ... doz. pairs	$2\frac{1}{2}$	3 0 doz. pairs	7 8			
Sundries	...	.....	0 8			
		Total Materials.	46 6			
Labour						
On frames ... C.F.	2·15	0 5 C.F.	0 11			
On outer shutters. S.F.	20	0 6 S.F.	7 8			
On inner do. S.F.	20	0 5 S.F.	6 4			
		Total Labour ...	14 7			
Total for	20	Square Feet ...	60 13			
		Or per Square Foot ... Rs.	3 1			

LXXXVII.—Windows, Glass, and Venetian Shutters, 2nd Class.

$4' \times 5' \times 1\frac{1}{4}''$.

Labour and Materials for 20 Square Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Teakwood ... C.F.	6	3 0 C.F.	15 0			
Glass, panes of. 11″ × 9″ No.	20	0 4 each,	5 0			
Butt hinges, iron, 4″ pairs.	2	5 12 doz. pairs	0 15			
Back flap do. do, 4″ pairs	2	1 4 pair	2 8			
Bolts, iron, 8″ ... No.	2	6 0 dozen	1 0			
Do. do. 6″ No.	4	4 0 do.	1 5			
Handles, iron ... No.	4	0 4 each	1 0			
Hooks, iron ... No.	4	0 2 do.	0 8			
Clips and wire for fastening blades.	...	.....	2 4			
Sundries	...	.....	0 7			
		Total Materials.	29 15			
Labour.						
On frames ... C.F.	2·15	0 5 C.F.	0 11			
On outer shutters. S.F.	20	0 6 S.F.	7 8			
On inner do. S.	20	0 5 S.F.	6 4			
		Total Labour.	14 7			
Total for	20	Square Feet...	44 6			
		Or per Square Foot ... Rs.	2 4			

LXXXVIII.—Windows, Glazed, Barred, and Shutters.

3′ × 4′ × 1″.

Labour and Materials for 12 Square Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount.
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Teakwood ... C.F.	35·0	3 0 C.F.	10 8			
Glass, panes of ... No.	20	0 4 each.	5 0			
Butt hinges, iron, 3½″ pairs	2	4 12 doz. pairs	0 13			
Back flap do. do. 4″ pairs.	2	1 4 pair	2 8			
Bolts, iron, 8″ ... No.	2	6 0 dozen	1 0			
do. 6″ ... No.	4	4 0 do.	1 5			
Handles, iron ... No.	4	0 4 each	1 0			
Hooks, iron ... No.	4	0 2 do.	0 8			
Iron, round, ¾″... lbs.	68	0 1 lbs.	4 4			
Sundries	...	.....	0 8			
		Total Materials.	27 6			
Labour.						
On frames ... C.F.	1·31	0 5 C.F.	0 7			
On outer shutters. S.F.	12	0 1½ S.F.	1 2			
On inner do. ... S.F.	12	0 3½ S.F.	2 10			
On fixing iron bars. S.F.	12	0 1 S.F.	0 12			
		Total Labour.	4 15			
Total for	12	Square Feet...	32 5			
		Or per Square Foot...Rs.	2 11			

VI.—CEILINGS, PLASTERING, &c.

Ceilings.

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VI.—CEILINGS, PLASTERING, &c.

LXXXIX.—Plank Ceilings.

Description. 1. To be of the best Moulmein teak, or of good well seasoned pine as may be specified; and to be attached to the under side of the framework of the roof, so as to leave the principal roof timbers exposed to view.

Planking. 2. The boards to be ½ or ¾ inch thick and not exceeding 6 inches in width, of a uniform colour and width, tongued and grooved (or with shot edges ½" apart and a covering fillet) planed on the under side, beaded or bevelled at the edges as may be desired.

Laying. 3. The boards to be laid truly parallel or perpendicular to the walls, and screwed to the under side of the framework of roof with brass screws of the proper length. The end and side joints to be neat and close. The whole to receive a coat of boiled linseed oil and then to be varnished.

Wire netting. 4. When ceilings are screwed to the under side of rafters or purlins, the boards nearest the walls and ridges to be left out, and perforated zinc or galvanized wire netting ¾" mesh to be substituted for it.

Moulding. 5. Specify if wooden moulding to run round the top of walls is required.

XC.—Plank Ceilings with Joists.

Description. 1. To be similar in all respects, except the following, to Specification No. LXXXIX above.

2. The boards to be screwed to teak ceiling joists 2" × 2½" placed at 2 feet central distance apart, screwed to the under side of tie beams of trusses.

XCI.—Cloth Ceilings.

1. To be of strong country cloth stretched on light teakwood frames, which will rest on walls and be firmly screwed up to the tie beams. The under side of woodwork will be planed and the cloth nailed on in panels, leaving the wood-work exposed. The cloth will be whitewashed, and wood-work varnished or oiled.

XCII.—Lath and Plaster Ceilings.

Description. 1. To consist of split male bamboos 1¼" diameter, nailed to ceiling joists and covered above and below with lime mortar.

Laths. 2. The bamboos to be straight, and thoroughly seasoned. To be split in two, and nailed with the concave side downwards at clear distances of

$\frac{3}{8}$ inch apart to ceiling joists $2'' \times 3''$ at 2 feet central distance apart, and laid to break joint. The laths to be all fixed before any plastering is commenced, and to be well wetted before plastering is applied, as also before being fixed to joists.

3. Mortar to consist of equal parts of lime and sand with the addition of clean fresh hemp; cut into lengths from $1\frac{1}{2}$ to 2 inches, in the proportion of 1 lb. of hemp to 4 cubic feet of the dry ingredients of mortar. The plaster will be dashed firmly upon the laths, so as to force it between the interstices, and cause it to spread out above so as to form a shoulder resting on the lath. It will be kept wetted until fairly set and hard. The surface so formed to be thoroughly beaten, scored with a trowel and a second or finishing coat laid on $\frac{1}{4}$ inch thick and rubbed to a hard surface.

Plaster.

Whitewashing.

4. The plaster when thoroughly dry to be whitewashed.

Plastering.

XCIII.—Plastering rough, $\frac{3}{4}''$.

1. The joints of the work to be raked out at least $\frac{3}{4}$ inch deep, so as to afford a good hold for the plaster.

Raking out joints.

2. The face of the wall to be well washed and wetted with fresh water for 6 hours before the plaster is applied.

Wetting wall.

3. A "rendering" of plaster sufficiently thick to cover by $\frac{1}{4}''$ all projections of stones ($\frac{3}{4}''$ for rubble and $\frac{1}{2}''$ for brickwork should be generally sufficient) consisting of 1 part lime to 1 fine clean sharp sand, to be applied in an even and uniform coat, and to be well beaten with hand tappers.

4. Chopped hemp and jagree in the proportion of 6 lbs. of each to every 100 cubic feet of prepared mortar (or in such proportions as may be directed) to be added to the mortar.

Hemp and jagree.

If second coat is required.

5. The surface of the first coat of plaster to be well roughened while wet.

Roughen.

6. When sufficiently dry "set" with a coat of very fine lime mixed with hemp and jagree in the proportions above stated (or in such as may be directed) well rubbed in and smoothed off.

Set.

7. All mouldings will be worked true to a template and drawn neat, clean, and level. All exposed angles and junctions with door frames to be carefully finished.

Mouldings.

8. Arises to be beaded if ordered.

N.B.—Plaster to be measured on the length and height of the walls without deducting for openings which are held to be equivalent to returns and soffits.

Cornices and mouldings are to be paid for by the running foot.

Note.—The above plaster is suited for ordinary works. Several varieties of plaster for fine work are given in notes following specifications.

XCIV.—Plastering, Rough cast. ½ inch thick.

1. Is a rough plaster composed of slaked lime, mixed with coarse gravel and lime screenings, in such proportions as may be ordered, applied to the exterior of buildings about ½″ in thickness, dashed on to form a uniformly rough surface; if to be colour-washed mix the colour with the rough mortar.

XCV.—Brick rubbed rough Plaster.

1. Wet wall thoroughly, and then daub on a paste formed of pure or nearly pure lime and water at every few inches of wall, and rub freely with a soft red brick dipped in strong jagree water, say 1 lb. to the gallon. Continue the rubbing till it sets, which it does in a few minutes. The plaster should be just sufficient to hide all unequalities in the building courses.

XCVI.—Cement Plastering.

1. "Render" with a mortar of equal parts of Portland cement and fine sand one inch thick and roughen, but do not beat.

2. "Set" with a ⅛ inch coat of pure Portland cement, and well smooth off.

Pointing.

XCVII and XCVIII.—Lime Pointing.

When to be done.

1. Shall, if possible, be done while the mortar in the joints is "green" and fresh.

Raking out joints.

2. The old mortar shall be raked out of the joints at least ¾ inch deep. The dust shall then be brushed out of the joints, and the work well wetted and washed with water.

Proportions.

3. The pointing shall then be made with fine mortar of equal proportions of lime and fine sand to every cubic foot of which will be added one pound of hemp chopped fine.

Joints, raised or flat.

4. The joints of the pointed work shall be neatly defined by the pointing, and the lines shall be regular and uniform in breadth, and the joints shall be raised or flat as may be directed.

Wetting.

5. The work pointed shall be kept wet for 3 days after the pointing is complete.

Face work.

6. All face or visible work shall be pointed, unless otherwise specified.

XCIX.—Cement Pointing.

1. Shall be executed as rapidly as possible, and not again touched after it has once begun to set, which it will do very soon. It must then be kept constantly wetted for some considerable time.

2. Mortar to consist of equal parts of Portland cement and sand.

PROBABLE COST OF EXECUTING WORKS ACCORDING TO THE ABOVE SPECIFICATION.

LXXXIX.—Plank Ceilings.

Artificers, Labourers, and Materials, for 100 Supl. Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Teak planking ½″ planed tongued and grooved 5½″ clear of tongue R. F.	220	7 0 100 R.F.	15 6			
Screws, brass, 1¼″ dozen.	10	0 2 dozen	1 4			
Sundries	...	.....	0 4			
		Total Materials.	16 14			
Labour.						
Carriage	...	.....	2 0			
Carpenters	2	0 12 each	1 8			
Coolies	2	0 4 do.	0 8			
Sundries	...	.....	0 4			
		Total Labour...	4 4			
Add—						
Varnish 2 coats. S.F....	100	4 12 100	4 12			
Total for 100 Supl. ft. including for varnishing			25 14		Total for 100 Supl. ft. including for varnishing ...	

Note.—¾″ teak plank costs about 3/ more per 100 R. F. than ½″. ¾″ deal plank about 2/ less.

XC.—Plank Ceilings, with Joists.

Labour and Materials for 100 Square Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount.
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Teak wood for frame work ... C. F.	2	3 0 C.F.	6 0			
Teak planking $\frac{1}{2}$" planed tongued and grooved $5\frac{1}{2}$" clear of tongue R. F.	220	7 0 100R.F.	15 6			
Screws, brass, $1\frac{1}{4}$" dozen.	10	0 2 dozen	1 4			
Sundries	...	.....	0 4			
		Total Materials.	22 14			
Labour.						
On wrought timber C. F.	2	0 6 C.F.	0 12			
On laying planking S. F.	100	2 4 100S.F.	2 4			
Carriage		.....	3 0			
Sundries		.....	0 8			
		Total Labour...	6 8			
Add—						
Varnish 2 coats S. F.	100	4 12 100	4 12			
Total for 100 S. F. including Varnishing.			34 12			

XCI.—Cloth-ceiling.

Artificers, Labourers, and Materials, for 100 Supl. Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Teak for framework C. F.	2	3 0 C. F.	6 0			
Dungree cloth Supl. ft.	110	3 0 100 Supl. ft.	3 5			
Nails ... ... lbs.	1	1 0 6 lbs.	0 3			
Tacks, tinned ... lbs.	¼	0 4 lbs.	0 1			
Tape ... R. ft.	40	.....	0 2			
Sundries	...	.....	0 4			
		Total Materials.	9 15			
Labour.						
Carpenters	3	0 12 each.	2 4			
Coolies	3	0 3 do.	0 9			
Tailor	¼	0 12 do.	0 3			
Sundries	...	.....	0 4			
	...	Total Labour...	3 4			
Total for 100 Supl. feet cloth-ceiling ...			13 3		Total for 100 Supl. feet cloth-ceiling...	
Add for whitewashing ...			0 8		Add for whitewashing	
Total for 100 Supl. feet including whitewashing.			13 11		Total for 100 Supl. feet including whitewashing.	

XCII.—Lath and Plaster Ceilings.

Labour and Materials for 100 Square Feet.	No. or quantity.	Rate.	Amount.	No. or quantity.	Rate.	Amount.
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Lime, slaked ... C. F.	20	12 0 40	6 0			
Sand ... ... C. F.	20	2 0 100	0 6			
Bamboos ... No.	54	5 0 100	2 11			
Fuel for straightening Bamboos	...	.....	0 4			
Hemp	...	.....	0 4			
Nails, 1½" long... No.	450	0 2 100	0 9			
Screws, 3" do, ... No.	16	4 0 Gross	0 7			
Sundries	...	.....	0 9			
		Total Materials .	11 2			
Labour.						
Carpenters ... No.	6	0 12 each.	4 8			
Masons ... No.	8	0 10 do.	5 0			
Coolies... ... No.	8	0 3 do.	1 8			
Bhisties ... No.	1	0 8 do.	0 8			
Scaffolding	...	.....	0 4			
Sundries	...	.....	0 8			
		Total Labour...	12 4			
Total for 100 Square Feet ...			23 6			

XCIII.—Plastering, rough, $\frac{3}{4}$".

Artificers, Labourers, and Materials for 100 Supl. Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Lime, slaked ... C. F.	6	12 0 40 C. F.	1 13			
Sand ... ... C. F.	6	2 0 100 C. F.	0 2			
Sundries such as hemp, jagri, &c.	...	... ...	0 5			
		Total Materials.	2 4			
Labour.						
Bricklayers No.	1½	0 10 each.	0 15			
Coolies	1	0 3 do.	0 3			
Women	4	0 2 do.	0 8			
Bhisties	¼	0 8 do.	0 2			
Grinding chunam twice C. F.	6	7 0 100 C. F.	0 7			
Sundries	...	... ...	0. 3			
		Total Labour .	2 6			
Total for 100 Supl. Feet...			4 10	Total for 100 Supl. Ft.		

N.B.—For fine coat see next page.

Fine Coat.

Artificers, Labourers, and Materials for 100 Supl. Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Lime, fine ... C. F.	2	16 0 40 C.F.	0 13			
Sundries	...	... ...	0 2			
		Total Materials.	0 15			
Labour.						
Bricklayers ... No.	1½	0 10 each.	0 15			
Coolies	1	0 3 do.	0 3			
Women	4	0 2 do.	0 8			
Bhisties	½	0 8 do.	0 2			
Sundries	...	... ...	0 2			
		Total Labour...	1 14			
Total for 100 Supl. Feet ...			2 13	Total for 100 Supl. feet.		

XCIV.—Plastering, Rough cast, ½ inch thick.

Artificers, Labourers and Materials for 100 Supl. Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Lime, slaked C. F.	4	12 0 40 C. F.	1 3			
Gravel, coarse C. F.	3	4 0 100 C. F.	0 2			
Lime-screenings C. F.	3	4 0 do.	0 2			
Sundries	...	... ...	0 2			
		Total Materials.	1 9			
Labour.						
Bricklayers No.	¾	0 10 each.	0 8			
Coolies	¾	0 3 do.	0 2			
Women	½	0 2 do.	0 1			
Bhisties	⅛	0 8 do.	0 1			
Sundries	...	... ...	0 2			
		Total Labour..	0 14			
Total for 100 Supl. Feet...			2 7	Total for 100 Supl. Ft.		

XCV.—Brick-rubbed rough Plaster.

This description of work can be done at the rate of about 12 annas per 100 square feet.

XCVI.—Cement Plastering.

Artificers, Labourers and Materials for 100 Supl. Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Portland Cement, 1 cask or... C. F.	4	12 0 4 C. F.	12 0			
Sand	4	2 0 100 C. F.	0 1			
Sundries	...	... ...	0 4			
		Total Materials.	12 5			
Labour.						
Bricklayers No.	3	0 10 each.	1 14			
Coolies	1	0 3 do.	0 3			
Women	3	0 2 do.	0 6			
Bhisties	¼	0 8 do.	0 2			
Sundries	...	... ...	0 4			
		Total Labour...	2 13			
		Total for 100 Supl. Feet...	15 2		Total for 100 Supl. Ft.	

XCVII.—Lime Pointing (Masonry).

Labour and Materials for 100 Square Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Lime, slaked ... C. F.	1¼	12 0 40 C.F.	0 6			
Sand ... ... C. F.	1¼	2 0 100 C.F.	0 1			
Sundries	...	... ...	0 4			
		Total Materials.	0 11			
Labour.						
Bricklayers ... No.	1½	0 10 each.	0 15			
Women ... No.	2	0 2 do.	0 4			
Bhisties ... No.	¼	0 8 do.	0 2			
Sundries	...	... ...	0 4			
		Total Labour...	1 9			
Total for 100 Square Feet...			2 4			

XCVIII.—Lime Pointing (Brick-work).

Labour and Materials for 100 Square Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Lime, slaked ... C. F.	2	12 0 40 C.F.	0 9			
Sand ... ... C. F.	2	2 0 100 C.F.	0 1			
Sundries	...	... ...	0 4			
		Total Materials.	0 14			
Labour.						
Bricklayers ... No.	2	0 10 each.	1 4			
Women ... No.	2	0 2 do.	0 4			
Bhisties ... No.	¼	0 8 do.	0 2			
Sundries	...	... ...	0 4			
		Total Labour...	1 14			
Total for 100 Square Feet...			2 12			

XCIX.—Cement Pointing.

Artificers, Labourers and Materials for 100 Supl. Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Portland Cement, $\frac{1}{6}$ Cask or C. F.	$\frac{2}{3}$	12 0 4 C. F.	2 0			
Sand	$\frac{2}{3}$	2 0 100 C. F.	0 1			
Sundries	...	... ...	0 1			
		Total Materials.	2 2			
Labour.						
Bricklayers No.	$1\frac{1}{2}$	0 10 each	0 15			
Women	2	0 2 do.	0 4			
Bhisties	$\frac{1}{8}$	0 8 do.	0 1			
Sundries	...	... ...	0 1			
		Total Labour...	1 5			
		Total for 100 Supl. Feet...	3 7		Total for 100 Supl. Ft.	

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VII.—ROOFING SPECIFICATIONS.

1. Specify whether timber is to be wrought, planed, framed, beaded, chamfered, &c.

2. *Unwrought* materials are such as are merely sawn out, but not worked or fitted in any way.

3. *Wrought* materials are those that have been planed, or worked, or fitted in any way.

4. *Framed work* is when two or more timbers are morticed and tenoned together, or scarfed, such as trusses: but wall plates, or purlins that are merely checked on to each other, are only considered as wrought.

5. The wood-work of roofs should invariably be estimated separately from the covering, as otherwise the rate per square will vary with the length and breadth of every building. The wood-work should include trusses, purlins, wall plates, rafters, &c.

6. A fair rate to take for labour on framed work, is 12 annas per C. F. including fixing in place. For wrought work such as purlins, wall plates, &c., 6 annas per C. F. will suffice.

7. To find out a rate for a total quantity of 100 C. F. of timber in roof take as follows:—

Materials and Labour.	No. or quantity.	Rate.	Amount.	No. or quantity.	Rate.	Amount.
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Timber in scantling in Bombay .. .. .. C. F.	100	3 0 C. F.	300 0			
Iron work in trusses, &c. Cwt.		21 0 Cwt.	21 0			
Nails for Purlin blocks, &c. Cwt.	1	14 0 Cwt.	7 0			
Sundries	..	.. ..	2 8			
Labour.						
On framed timber .. C. F.	25	0 12 C. F.	18 12			
On wrought timber .. C. F.	75	0 6 C. F.	28 2			
On fitting iron-work	..	.. ..	7 0			
Carriage of timber .. C. F.	100	0 4 C. F.	25 0			
Sundries	..	.. ..	2 8			
		For 100 C. F. of timber ..	411 14		For 100 C. F. of timber.	
		Or per C. F. very nearly ..	4 2		Or per C. F. very nearly.	

Enter in abstract of Estimate 100 C. F. of teak at Rs. 4-2-0 per C. F.

8. To find a rate for double tiled roofing for example, work out the quantities of wood-work, double tiling, ridges and hips, eaves and eaves board as follows:—

Labourers and Materials for Superficial Feet of Roofing.	No. or quantity.	Rate.	Amount.	No. or quantity.	Rate.	Amount.
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Wood-work.. .. .. C. F.						
Double tiling .. .. S. F.						
Setting ridges and hips in chunam .. .. .. R. F.						
Setting double eaves in chunam .. .. .. R. F.						
Eaves board.. .. .. R. F.						
Total for 1 S. F. of roof-covering completed .. Or for 100 S. F. of do. ..				Total for S. F. of roof covering completed .. .. Or for 100 S. F. of do.		

C to CIII.—Double Tiled Roof Covering.

Tiles. 1. To be of sound, well burnt tiles $10'' \times 3\frac{1}{4}''$, free from flaws and defects, and fitting about 3″ into one another.

Hips, ridges, and eaves. 2. The eaves to be set in mortar. The ridges and hips to be of ridge tiles carefully set in mortar, but not plastered.

Soaking. 3. All tiles to be soaked for 12 hours before use, in water mixed with cowdung, before being used on the work.

Battens. 4. The battens to be of sawn teak scantlings $2'' \times \frac{1}{2}''$ placed 2 inches clear distance apart.

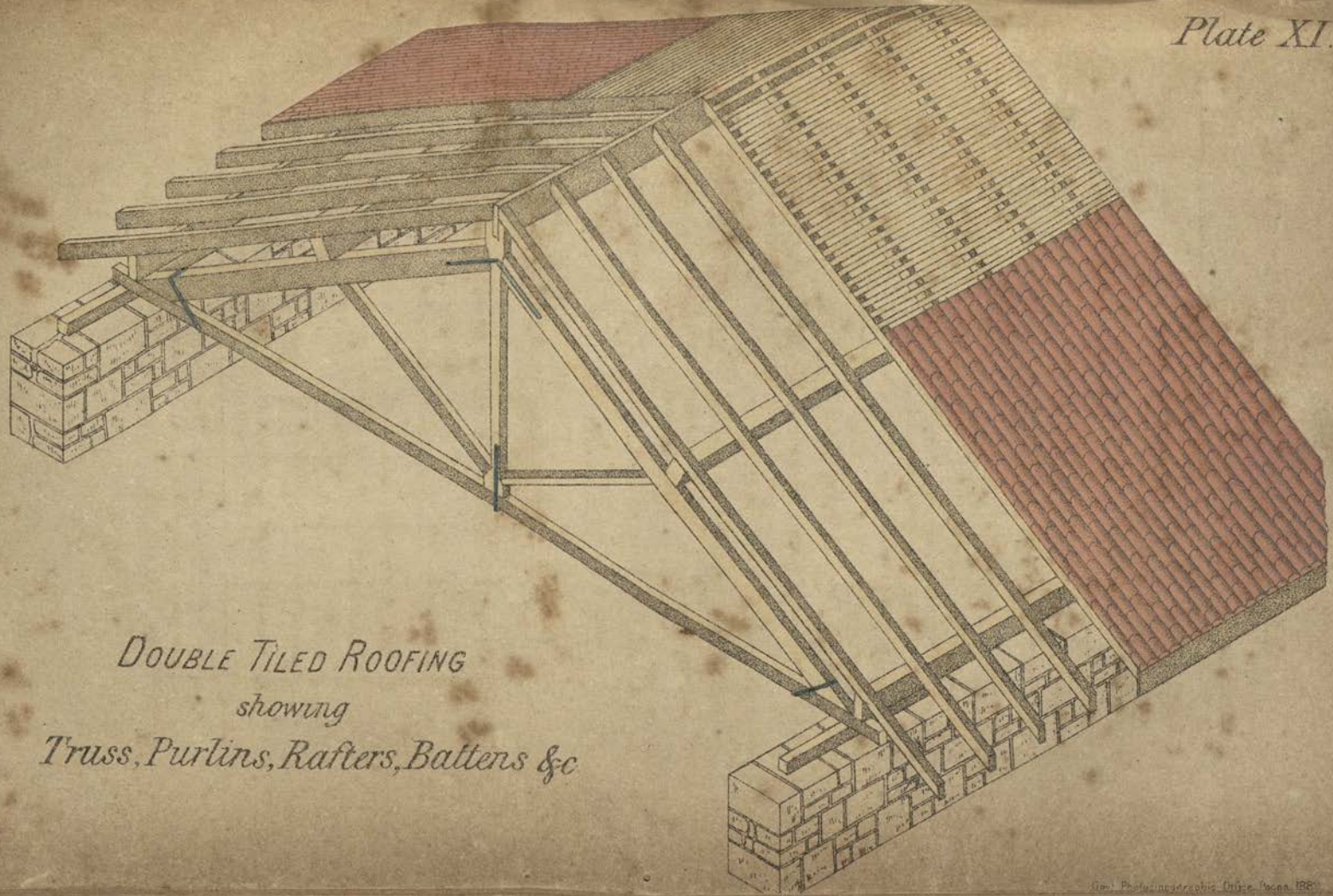
CIV to CXIII.—Double Tiled Roofing—(Ordinary Construction)

Roof covering. 1. Roof covering to be as specified in Nos. C to CIII above.

Wood-work. 2. All wood-work to be of well-seasoned Moulmein Teak neatly planed, varnished or painted, and in other respects as specified for wood-work, in general (Specification No. XIV). The unexposed portions of the timber to be worked smooth, but not planed.

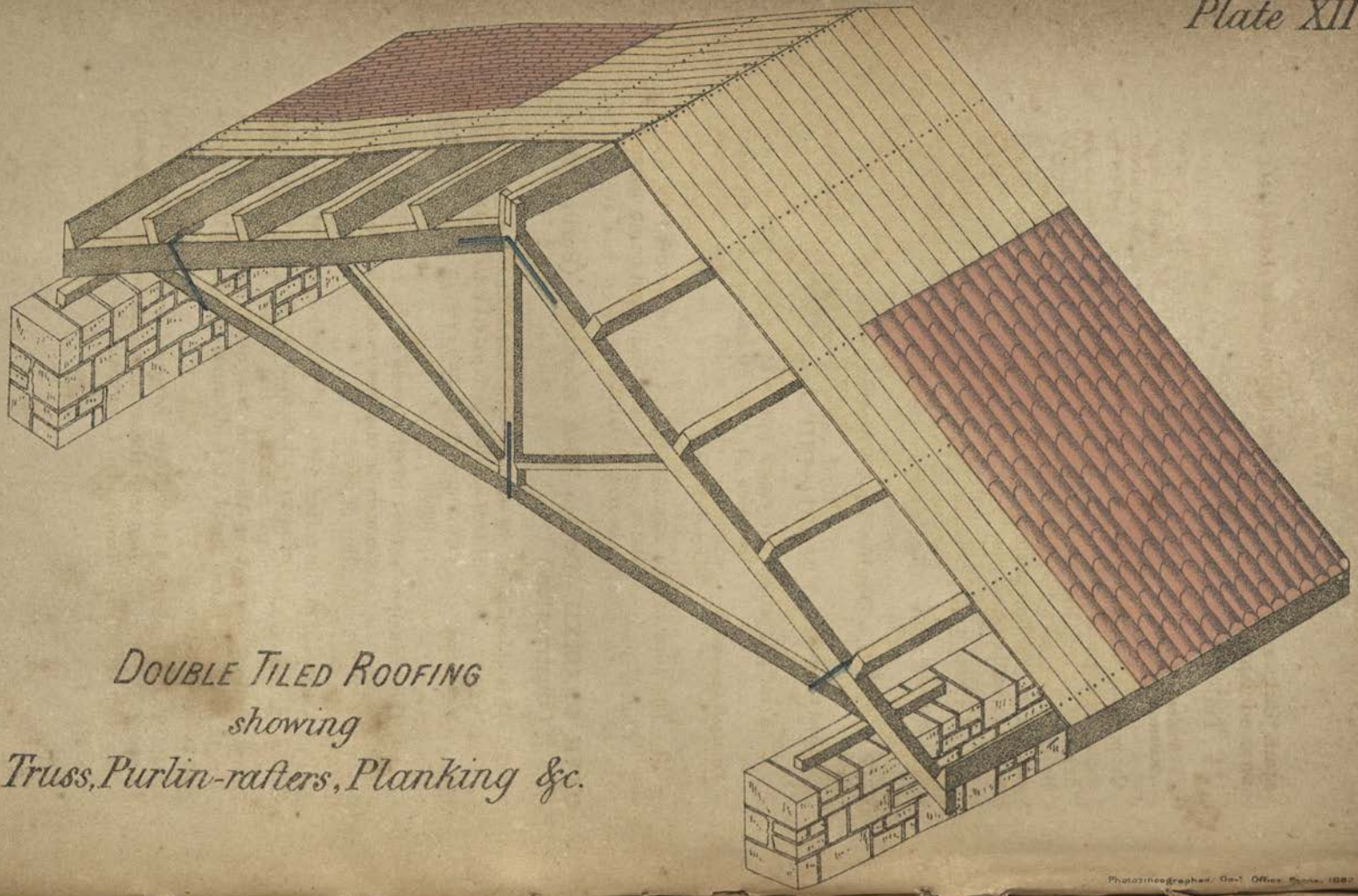
Trusses. 3. The trusses to be constructed in accordance with the drawings furnished; all mortice and tenon joints, scarfs, &c., to be fitted together accurately in a workmanlike manner. The scantlings of the different parts, unless otherwise specified, to be in accordance with those given in Tables VIII and IX. To be placed at 10 feet central distance

Plate XI.



DOUBLE TILED ROOFING
showing
Truss, Purlins, Rafters, Battens &c

Govt. Photolithographic Office, Poona 1887



DOUBLE TILED ROOFING
showing
Truss, Purlin-rafters, Planking &c.

Photozincographed, Genl Office, Perth, 1882

apart, their ends well tarred, bearing on stone bed plates or wooden templates.

Purlins, Common Rafters, &c.

4. Purlins, common rafters, &c., to be of the scantlings given in Table IX. Purlins to be in the greatest lengths procurable, and to be scarfed together, wherever necessary, immediately above the principal rafter of the truss on which the ends rest, and to be secured in position by purlin blocks. Common rafters to be fixed at central distances apart not exceeding 18 inches, and to be in continuous lengths from ridge to eaves (wherever possible), notched to fit the purlin, with their lower ends notched and nailed to wall plates.

Iron-work.

5. All iron straps, bolts, &c., used in the work to be of good workmanship, and to be dipped in common Teel oil while red-hot.

CXIV to CXVI.—Double Tiled Verandah Roofing.

Roof Covering.

1. Roof covering to be as specified in Nos. C to CIII above.

Principals and purlins.

2. Principal rafters carrying a purlin to be placed at central distances of 8 to 10 feet apart in all cases when the clear width of the verandah exceeds 8 feet.

Common rafters.

3. The tops of the common rafters to be secured to wall plates laid in the wall, and on no account to be merely built into it.

CXVII to CXXII.—Double Tiled Roofing. (Purlin-rafter Construction.)

Description.

1. This description of roofing will correspond generally to that described in Nos. CIV to CXIII above, differing from it, however, in the following respects.

Trusses.

2. The principal rafters of the truss to be extended continuously in one piece on either side to the line of eaves.

Purlin rafters.

3. A series of purlin rafters $4\frac{1}{2}'' \times 6\frac{1}{4}''$ placed at central distances of about 3 feet apart to be laid on the principal rafters of the trusses, (similar to ordinary purlins) secured to them in the usual way, and to be in length not less than double the distance at which the trusses are set apart.

Teak planking.

4. Teak planking $\frac{3}{4}$ inch thick, tongued and grooved, to be laid on these purlin rafters continuously from ridge to eaves in lieu of battens.

5. The tiles to be laid in the ordinary way on the planking, which latter, however, should be omitted over the walls, and the tiles there set in mortar to prevent them slipping.

Tiling.

Note.—The purlin rafters may be set, if desired, at central distances of 2 feet apart. In that case their scantling should be 4″×5½″. The cost of the roof would, however, be more than if placed 3 feet apart, and of the scantling specified in para. 3 above.

CXXIII to CXXV.—Galvanized, Corrugated Iron Roof Covering.

1. To be of sound, galvanized, corrugated iron of 20, 18, or 16 B. W. G. as may be specified, uninjured in the carriage by the rubbing of the zinc covering, or otherwise.

Guage.

2. The sheets to be laid with laps of 6″ at the ends and 2 corrugations at the sides, and vertical laps to be turned away from the rainy quarter.

Laps.

3. The holes for the rivets are to be drilled (not punched) from the inside towards the outside, at a distance of about 9″ apart on the sides, and every second corrugation on the ends.

Drillings.

4. The sheets when so fastened with the best galvanized rivets and lead washers are to be set carefully on the purlins, and fastened to them by Allen's or other approved fasteners, galvanized iron screws and washers, or by bolts, as may be shown in the drawings.

Fastening down.

These bolts to be placed 5 feet horizontally and in the same line in the direction of the slope over each purlin, care being taken in the case of rivets and bolts that the holes to receive them are drilled in the *ridge* of the corrugation.

5. Ridges and hips to be of neat zinc, 20 B. W. G., with a foot lap on each side securely fastened down so as to prevent the rain driving under it.

Ridges.

Note.—In open sheds or verandahs where wind can get under the roof, it is absolutely necessary to fasten down the plates by continuous lengths of wrought iron about 2″×¼″ bolted through the purlins, and also to secure the purlins by bolting them down to the masonry or other posts.

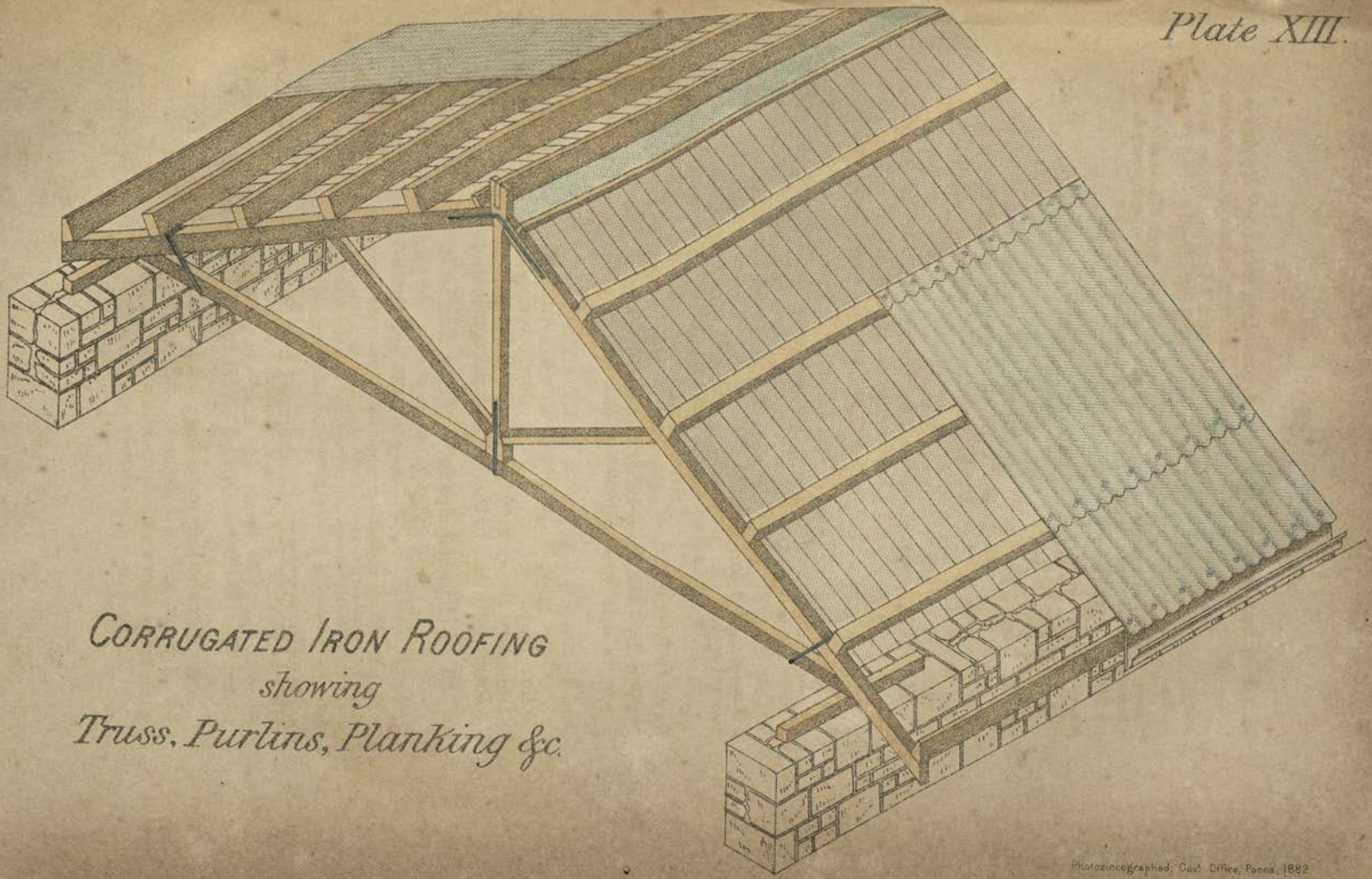
CXXVI to CXXXI.—Corrugated Iron Roofing. 20 B. W. G.

1. Roof covering to be as specified in Nos. CXXIII to CXXV above.

Roof covering.

2. The sheeting to be supported on teak purlins and trusses, (which will accord generally with the conditions laid down in Specification No. CIV. above), in the manner described below.

Timber frame work.



CORRUGATED IRON ROOFING
showing
Truss, Purlins, Planking &c.

Photozincographed, Civil Office, Poona, 1882

3. A series of longitudinal purlins will be placed at central distances apart of about 3 feet, or of half of the length of each riveted sheet. On these the corrugated-iron sheeting will be laid, the overlapping and riveted ends of the sheets being secured to each *alternate* purlin by 3″ galvanized iron screws and washers about 6 inches apart.

Purlins.

4. Teak planking ½″ thick, tongued and grooved, will then be screwed to the *under side* of the purlins, extending from under ridge to walls, leaving thus an air chamber of the full depth of the purlins between the planking and roof covering above.

Teak planking.

5. The upper ends of this planking to be furnished off at a distance of about 6 inches on either side of the ridge, thus leaving an open space of about one foot under the ridge pole, which will be filled in with galvanized wire netting ¾″ to secure ventilation to the interior of the building.

Galvanized wire netting.

6. Eaves gutters to be provided.

CXXXII to CXXXIV.—Terraced Roofing.

1. To consist of one layer of flat tiles soaked in thick whitewash set in lime mortar over 3 inches of fine concrete placed on two layers of flat tiles also set in mortar, the whole supported on teak scantlings placed one foot apart.

Description.

2. The lower layers of flat tiles to measure 12″ × 6″ × 1″ and to be laid in two courses one above the other, breaking joint with another. Both layers to be laid with their sides well rubbed and drawn up with mortar. The upper layer to be embedded in mortar on the lower.

Flat tiles.

3. The concrete to be prepared in accordance with Specification No. LII, and to consist of lime, clean sharp sand, and screened shingle in the proportions therein named. After the concrete has been spread it will be wetted and beaten with light quick strokes with a hand flail till the mortar is drawn up to the surface and the mass is well set.

Concrete.

4. Covering the concrete a layer of tiles similar to those described in para. 2 will then be set. The tiles to be well soaked in thick whitewash, their sides rubbed and drawn up with mortar as above described.

Upper layer of tiles.

5. The whole to be supported on teak joists placed at central distances of 12 inches apart, and to be of the scantlings given in the foot-notes of the rates No. CXXXII to CXXXIV, unless otherwise specified. The joists to rest on wall plates 4″ × 3½″ built into the wall, or on corbels outside it.

Joists and wall plates.

Slope.

6. The roof to be laid with a slope of about ½ inch to a foot to prevent rain water lodging upon it.

String course.

7. At the junction of the roof covering with any wall a string course projecting not less than 4 inches to be built into the wall at a height of 2 inches above the upper surface of the roof, and the intervening space to be carefully filled in with concrete to prevent leakage down the wall.

CXXXV.—Zinc Roof Covering.

To be of 20, 19, or 18 B. W. gauge, "Italian corrugation", screwed to wooden rolls with patent embossed holes and screws, the screw not to penetrate both sheets at the lap. The horizontal joints to be made by folding laps secured by clips 2″ wide placed apart; care must be taken to give every facility to the zinc for expansion and contraction.

Note.—In Bombay zinc roofing has been found unsuitable to the climate, owing to its very great expansion and contraction.

CXXXVI.—Belgaum Roof Covering.

Consists of a layer of small flat tiles about 5″ × 5″ × ½″, with edges rubbed to make close joints, and soaked in *pure white* lime of about the consistency of cream, laid in mortar on sawn teak battens 2″ × ½″ placed 3″ apart; over them a ½″ layer of mortar and then a layer of ordinary native semi-cylindrical tiles about 14″ × 5″ is laid, eaves and ridges set in mortar.

Note—This makes a very nice roof.

CXXXVII.—Taylor's Patent Tiles.

Battens.

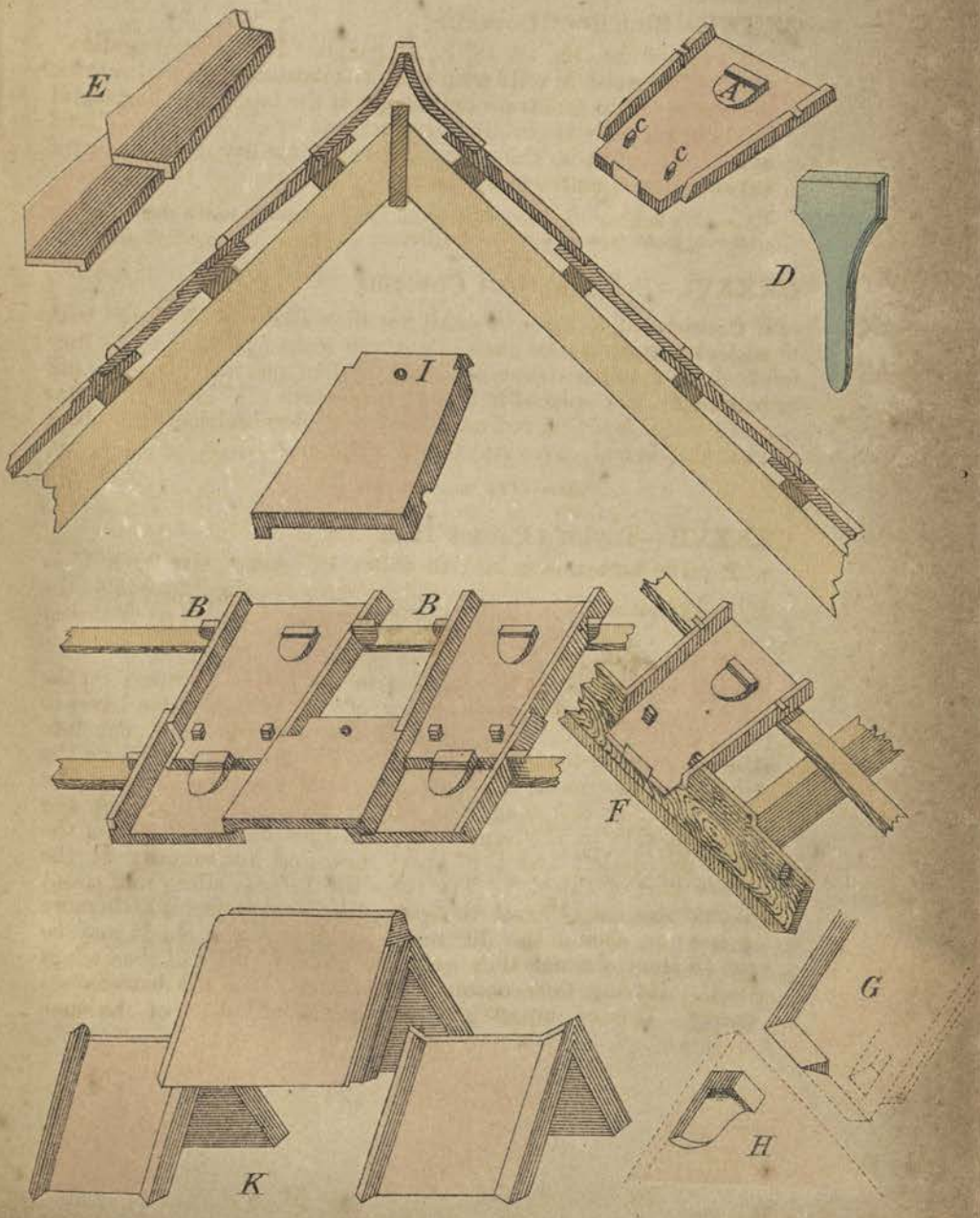
1. The battens are laid to about 10″ guage, size 3″ × 1″ or ¾″, the width being required to enable the upper tile it bears to be nailed as described in paragraph 4.

Fixing battens.

2. Before nailing the battens to the rafters, arrange on the roof one row of channel tiles from eaves to ridge, fitting the narrow end of one into the wide end of the other, the shield A (see Plate XIV) on the tile being uppermost, the centre of which should be ¾″ above the nail nitch, in the flanges as at B. Then take a row up the opposite side in the same way, the tiles on either side of the ridge to be left about 8″ apart measured horizontally at the upper part of shield A. (Try ridge tile before nailing roof tiles.) Should this not be exact, the eaves tiles may project a little more or less; or, should the difference be greater, the shield may be cut off from channel tiles next the ridge, which will then adapt itself. Having thus obtained the gauge, nail the battens securely. It is of importance that they should all be of the same thickness.

Taylor's Patent Tiles.

A Section through the Roof & a few tiles.
a nail two hip tiles &c.



Govt. Photozincographic Office, Poona. 1882.

3. Arrange the tiles along the whole length of the rule so as to determine whether the ends shall finish with a row of under or upper tiles (the latter is preferable). If the finish is made with the upper tiles they should rest upon an $1\frac{1}{4}''$ batten laid right up the roof just within the stop C nearest to the outer ridge of the tile. The tiles should project a little over. If the finish is made with the under tiles, the batten is not required.

Ends.

Fixing tiles on roof.

4. Commence at the eaves with channel tiles and lay them to a line to the ridge fitting the narrow end of the one tile into the wide end of the next, shield A being uppermost, the wide end of the tile just touching the line, which must be perfectly square to the ridge. Arrange in like manner the next row of channel tiles, carefully leaving between them the exact space required for upper tiles, then nail the channel tiles with the patent wedge-shaped nail D, driven into the batten at the nitches on each side of the tile as at B, taking care to drive the nail in, at right angles to the batten.

Under or Channel Tiles.

5. The space between the two rows of channel tiles to be capped by a tile turned the reverse way to the channel tile, viz., wide end down, plain side uppermost, its flanges capping over the up-turned flanges of the channel tile, the two small blocks C.C. at narrow end of tile resting on the patent nails as at B. The rest of the upper tiles will follow in the same manner, forming a $2\frac{1}{2}''$ lap over the upper tile beneath it, and should be gently wedged down so that the splay as at G, at the narrow end of the tile beneath it, shall securely dovetail into the undercut, the shield of the tile being wedged as at H. In no case should the tiles be laid so far apart as to require cutting or chipping.

Upper or Capping Tiles.

6. The upper tiles should be drilled as at I., $1''$ from the edge in the middle of the narrow end of the tile and be nailed to the batten with a $2\frac{1}{2}''$ galvanised nail.

Drilling and Nailing Upper Tiles.

7. Consist of an upper ridge tile with flange turned downwards, capping over the under-ridge tiles with flanges turned upwards, the under ridge being placed upon the channel tiles. The ridge should be bedded in mortar and pointed with cement.

Ridge Tiles as at K.

8. The roof tiles to be cut to the hip tiles, and the latter to be set in mortar and cement pointed.

Hip Tiles as at E.

9. A thin batten should be scribed to the underside of the tile to fill up the vacuum under the upper tiles; the board to be nailed on the usual facial board or rafter feet.

Finish at eaves as at F.

Valleys. 10. To be of lead or zinc as in No. CXLVI, to which the roof tiles will be cut.

CXXXVIII.—Mangalore Tiles, patent.

Laid single as per sketch (see Plate XV) on battens 1″ × 1¾″ and 12½″ from centre to centre. Ridge, hips, &c., set in mortar.

CXXXIX.—Goodwyn's Tiles

Are generally laid as follows :—

1. A layer of flat square tiles 12″ square and 1″ thick, made of well-tempered clay thoroughly burnt, not vitrified, without flaws or twists, sound, of regular shape, with sharp square edges and ringing well, is laid with close joints not exceeding $\frac{3}{16}$″ in thickness in mortar on batttens 3″ × 2″ and 12″ from centre to centre nailed on to purlins. (When more than one course is laid, the second layer breaks joint with the first, and has not less than ½″ mortar between them).

Flat Tiles.

2. On this 1½″ of mortar is laid, in which Goodwyn's tiles are well embedded at regular intervals, the spaces between them being filled up with mortar.

Upper Tiles.

CXL.—Atkinson's Tiles.

1. This pattern consists of two layers of tiles, the upper being Italian pantiles laid in mortar over cylindrical tiles. The cylindrical tiles to be 12″ long, 4″ external diameter and ½″ thick, fitting ½″ into each other with a shoulder and socket joint, a lip to rest on the battens to be raised on it ½″ from the shoulder, 2 holes of ½″ diameter to be pierced through the tile in lime with the lip which is on the lower side of the tile. The tiles to be moulded of well-tempered clay, thoroughly burnt, sound, and of true shape without taper.

Cylindrical Tiles.

These cylindrical tiles are to be laid close with their axes up the slope of the roof, and covered with 3″ of mortar and in this, while wet, will be laid Italian pantiles.

2. The pantiles are to be 12″ long and 12″ wide over all, and not less than ½″ thick, of well-tempered clay, thoroughly burnt, free from twists, sound, and firm, and of uniform size and shape.

Pantiles.

The mortar in which the tiles are laid is to be drawn up, so as to fill the curved roll which overlaps at the vertical joint.

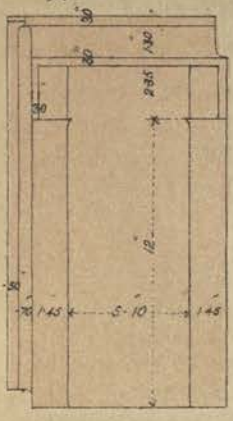
The lower edge of each pantile to overlap 3″ the tile below it, a lip to be rised on the under side of each tile to rest against the lower tile and prevent slipping.

See diagrams Plate XV.

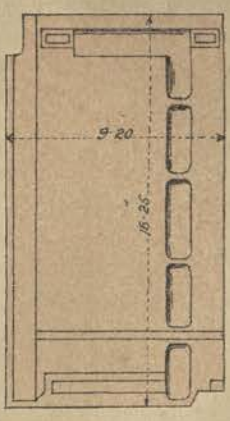
Mangalore Tiles

Plate XV.

Upper Side



Lower Side



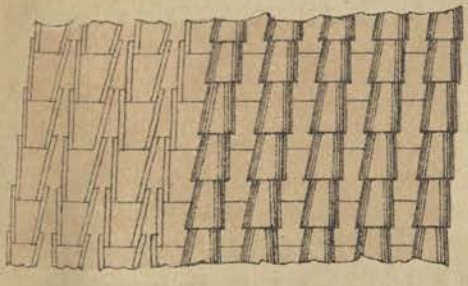
Longitudinal Section

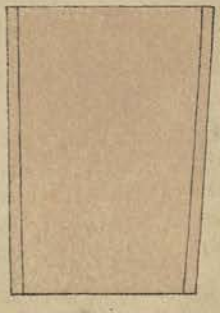
Longitudinal Section when adjusted

Cross Section

Cross Section when adjusted

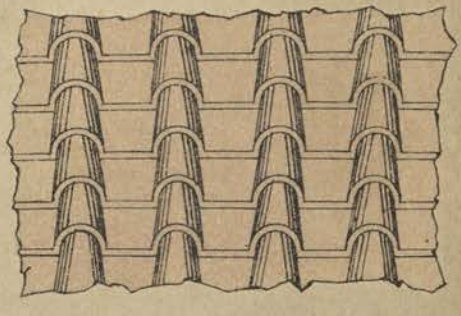
Goodwyn's Tiles



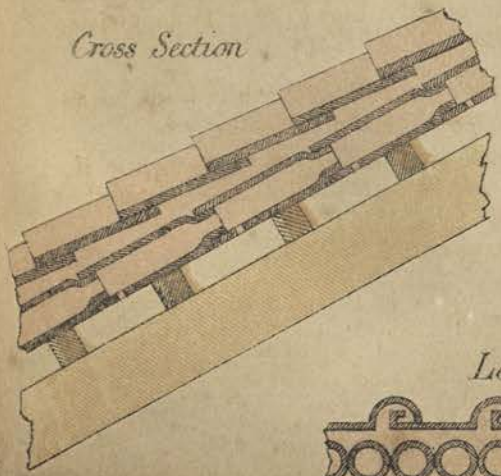


Atkinson's Tiles

Elevation



Cross Section

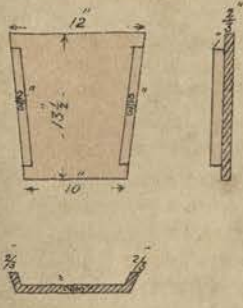


Longitudinal Section

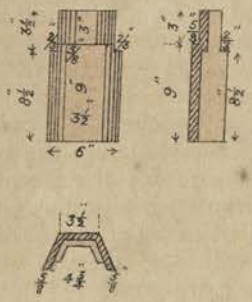
Govt Photozincographic Office, Poona. 1882

Hill's Tiles.

Lower Tile



Upper Tile

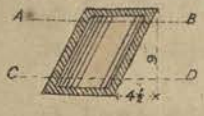


Single Tiles with double layer of flat tiles & terrace.

Double Tiles

Syrian Roof

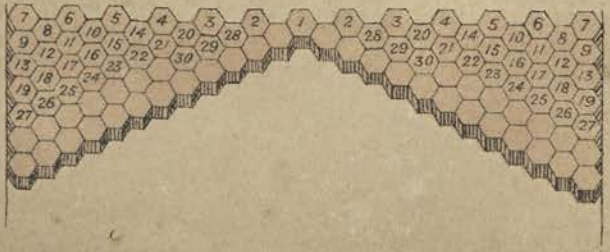
Section of Hollow Voussoir



Section A.B.

Section C.D.

Developed Plan of Vault in course of construction
End Wall



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CXLI.—Hills' Tiles.

1. Proposes to lay them single or double, or the reverse way to Goodwyn's; *i.e.*, the flat tiles to be set in mortar on the top of the semi-hexagonal tiles in two layers, over which ½″ of plaster is to be laid, so that birds, &c., cannot displace the tiles, and soldiers throwing stones will not injure the roof.

CXLII.—Syrian Roof as used in Sind.

1. Is formed of hollow hexagonal tiles which form a vault.

2. The haunches and end walls having been carried up to the requisite height, the 1st voussoir is let into the end wall at the crown of the curve, other voussoirs at proper intervals are then similarly let into the wall till the haunches are reached. About half of each voussoir ought to project outside the wall, and the intervals between each should be sufficiently large for the reception of half a voussior and its cement. The vaulting is then commenced at the angles, which are gradually filled in, each course of voussoirs being commenced at the end wall, and carried obliquely down to the haunch in the order they are numbered in the sketch.

Fixing Voussoirs.

The sides of voussoirs 6 and 7 and the wall in front being covered with cement, No. 8 is thrust in, care being taken to keep the top parallel to the direction of the vault.

3. The vault is kept in the proper curve by a circular piece of plank standing on the projecting bricks of the cornice, no centering being required. Mud and bhoosa is the cement generally used, and has been found quite sufficient. It requires plastering outside and plastering or pointing inside.

Centering.

CXLIII.—Wood Cement.

Said to be much used in parts of Germany.

1. Slope of roof to be at least ¾″ per foot.

Slope.

2. 1″ planking tongued and grooved is nailed to joists and covered with a layer of sand ½″ thick.

Planking.

3. Strong brown paper in continuous rolls and as broad as possible, is then laid on this, each length overlapping the next by at least 4″.

Paper.

4. Mix the ingredients in proportion of 100 lbs. tar to 180 lbs. Portland cement into an iron cauldron and heat, care being taken to heat the tar gently and mix the Portland cement with it gradually, in order to prevent its boiling over (1 lb. of powdered sulphur to every cwt. of P. C. is said to improve the mixture). This mixture

Ingredients.

must then be laid as hot as possible on the paper with a tar brush. The next layer of paper is then laid upon it, breaking joint with the last layer and smoothed with a light wooden roller. The 3rd and 4th layers are in like manner laid with alternate layers of wood, cement and paper. The last layer must be carefully covered with cement and then strewed with sifted ashes ¼″ thick.

5. The whole is then finished with a coating of sifted gravel containing about ⅓ of dry loam truly levelled with rakes and scrapers. Finishing.

Note.—Said to be cool, durable, and not affected by the sun.
May be covered with earth and used as gardens without injury.
Fresh cement is most suitable.
The mixture is improved by keeping and re-melting.

CXLIV.—Oropholite.

1. Is made of sharp river sand and chalk, with an admixture of litharge, all finely sifted and made into a paste with linseed oil. Ingredients.

2. This is spread on one or both sides of any kind of common coarse cloth, so as to form, when dry, a sheet about ⅜″ thick. The sheets when prepared are hung up to dry, and are then applied in pieces of such size as may be convenient. Cloth.

CXLV.—Dammering on Roof.

A coat of melted pitch is to be applied to the upper surface of the boarding; on this, before it hardens, tack down old tarpaulins smoothly and carefully laid with proper laps. On this another coat of pitch, with a smaller quantity of tar to take away its brittleness, mixed in it, is to be carefully laid on thoroughly spread and well worked in.

CXLVI and CXLVII.—Gutters, Valleys and Flashings.

1. Gutters should have a fall of at least 1″ in 10′, more being always given if possible. Fall.

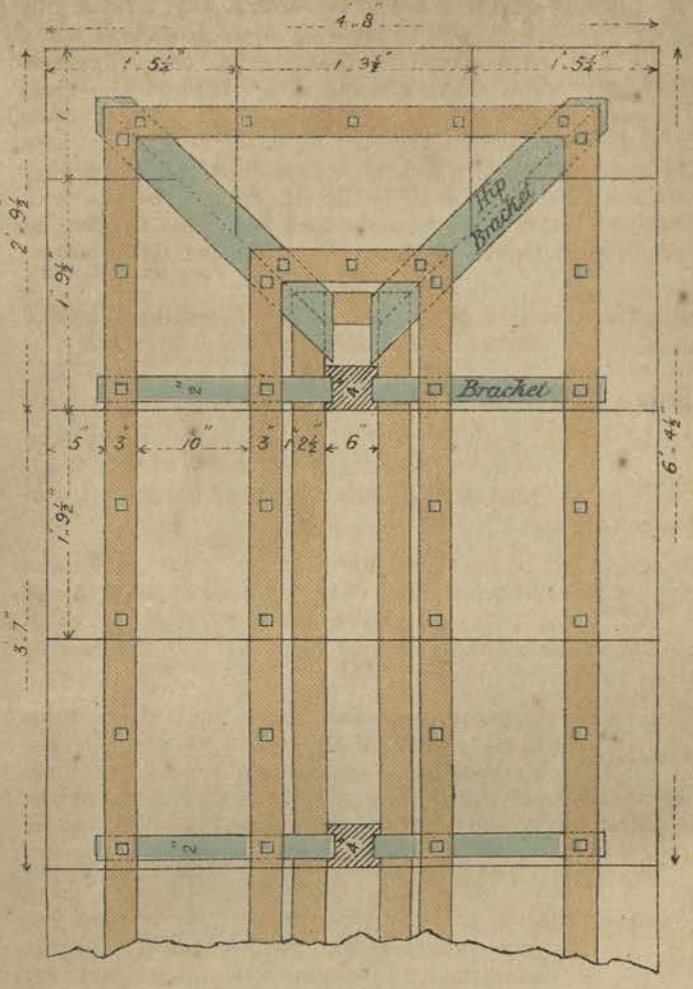
2. To consist of 1″ teak planking supported on bearers properly fastened to the rafters, not less than 6″ wide at bottom and turned up under the tiles 12″ on each side covered with (*a*) good milled lead not less than 6 lbs. to the square foot; (*b*), or sheet zinc, 18 or 19 B. W. G. copper nails to be used in fastening lead to wood-work; (*c*), or sheet iron not less than $\frac{1}{16}$″ thick bent to the shape required, properly secured to the boarding. Valleys.

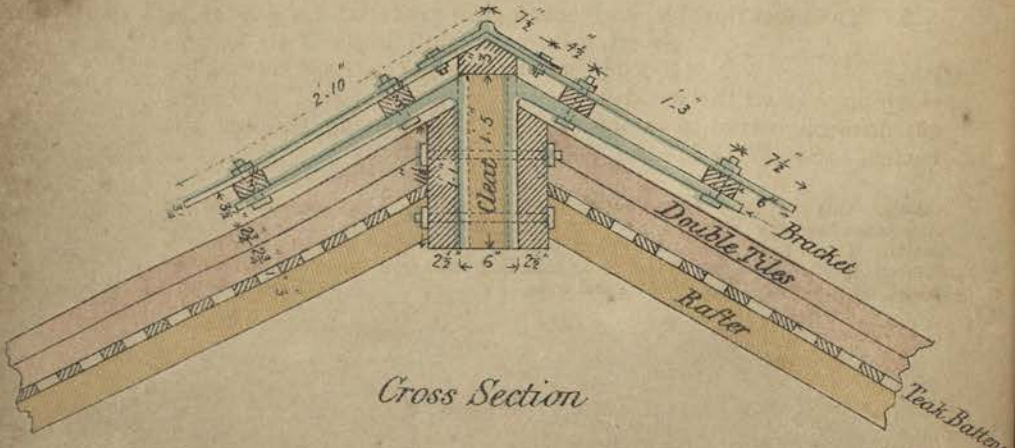
Boarding to be well dammered before lead, &c., is applied.

3. To be of 5 lbs. milled or lead 18 B. W. G. zinc, if possible built into the wall, or otherwise to be fastened into a groove ¾″ deep with wall hooks and Portland cement. Flashings.

Ridge Ventilator
(Howard's Pattern)

Plan





Cross Section

Govt. Photozincographic Office, Poona, 1882.

CXLVIII.—Down Pipes.

1. Down pipes of cast iron are costly and heavy. As a rule they will be made of sheet iron bent on a cylindrical core diameter and carefully riveted together, the sides having a lap of $\frac{5}{8}$″ beyond the rivet heads. The ends of the various lengths will butt firmly upon each other, and will be joined together by a collar of the same material, at least 6″ long, which will first be riveted together and then shrunk on. They shall be firmly secured to the wall by semicircular collars with flanges and flat nails 6″ long at intervals of not more than 6′ joints to be made perfectly watertight.

Sheet iron.

2. If sheet iron is not galvanized, it shall receive at least 3 coats of paint internally and externally.

Painting.

CXLIX.—Ridge Ventilator (Howard's Pattern.)

1. Two ridge poles each $2\frac{1}{2}'' \times 11\frac{1}{2}''$ will be employed placed on opposite sides of the head of the king-post with a clear space of 6 inches intervening between them.

Ridge poles.

2. This space will be preserved by means of cleats, or blocks of wood $17'' \times 6'' \times 4''$, placed at intervals of 3′ 7″ central distance along the length of the ridge. The space between the two ridge poles forms an exit for foul air.

Ventilating space.

3. To form a covering to protect the space, and at the same time to allow of the escape of foul air, the vertical limbs of two light cast-iron brackets are secured to the inner face of either ridge pole at the points where the cleats, above mentioned, occur. Two bolts are passed through the ridge poles, brackets, and cleats, thus securing them in their proper places.

Cast-iron brackets.

4. The sloping limb of the cast-iron bracket, which has the same angle as the roof, depends over the main roof, so forming a line of supports for the ridge covering.

Slope.

5. The most durable and economical material for the ridge covering is corrugated iron. Two battens $3'' \times 1\frac{1}{4}''$ on either bracket, together with a ridge piece is all the wood-work that is necessary. The corrugated iron is bolted to the bracket, the bolt passing through the batten. (See Plate XVII.)

Ventilator covering.

Note.—This ventilator is especially adapted for tiled roofs, and has been largely used on the barracks at Poona, Kirkee, Ahmedabad, Ahmednagar, Belgaum, and Deolâli. It can be adapted for either king or queen post trusses. Its cost in Bombay is Rs. 4-2-0 per lineal foot, including cast-iron brackets, corrugated sheets, ridge capping, and all bolts and nuts.

CL.—Lightning Conductors.

1. To be copper rod (or rope) $\frac{1}{2}''$ diameter, copper tape $1\frac{1}{2}'' \times \frac{1}{8}''$, or round iron rod 1″ diameter.

Materials.

2. The upper end of the conductor under all circumstances to be a solid copper rod $\frac{3}{4}''$ diameter terminated in a cone of which the height is equal to the radius of its base. To project at least 5 feet into the air above one or more of the highest points of the building to which it is applied.

Upper terminate or points.

Note.—It is desirable that the points be platinized, gilded or nickel-plated so as to resist oxidation.

3. The conductors to be attached to the building by proper hold-fasts, to be perfectly continuous from top to bottom, and preferentially to be taken down the side of the building most exposed to rain. All metal surfaces in ridges, roofs, gutters, &c., to be connected by plates of copper with the conducting system.

Conductor.

4. All joints in copper rods besides being well cleaned, screwed, scarfed, or riveted to be soldered in addition.

Joints.

5. The lower extremity of the conductor to be carried about 3 feet into the ground. A copper tape $1\frac{1}{2}'' \times \frac{1}{8}''$ to be then soldered to it, and carried along a trench 30 to 40 feet in length (of about the same depth) and connected with a copper plate not less than 9 square feet in area and $\frac{1}{16}$ inch thick buried in permanently wet earth and surrounded with charocal. The copper tape to be laid in charcoal, and the trench filled up with sand.

Earth connection.

6. The surface drainage in the vicinity to be regulated, if possible, to flow over the site of the trench.

Surface drainage.

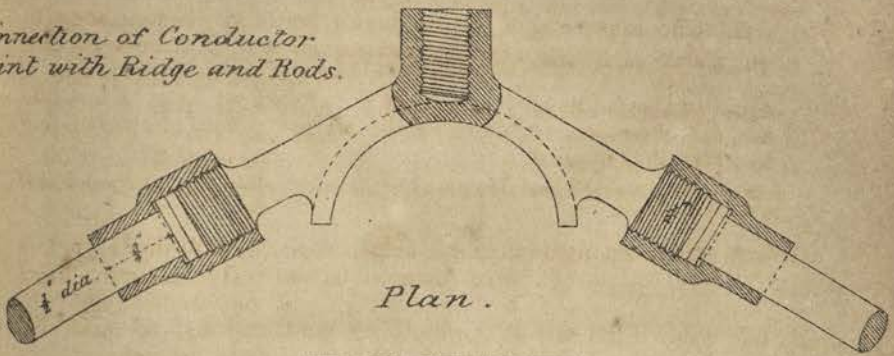
Note.—The copper used should not weigh less than 6 oz. per foot run, or its conductivity be less than 90 per cent. of that of pure copper. Iron may be used, but should weigh not less than $2\frac{1}{4}$ lbs. per foot run. If copper rope be used, no individual wire should be less than 12 B. W. G.—See also "Code of Rules for the Erection of Lightning Conductors."

LIGHTNING CONDUCTORS.

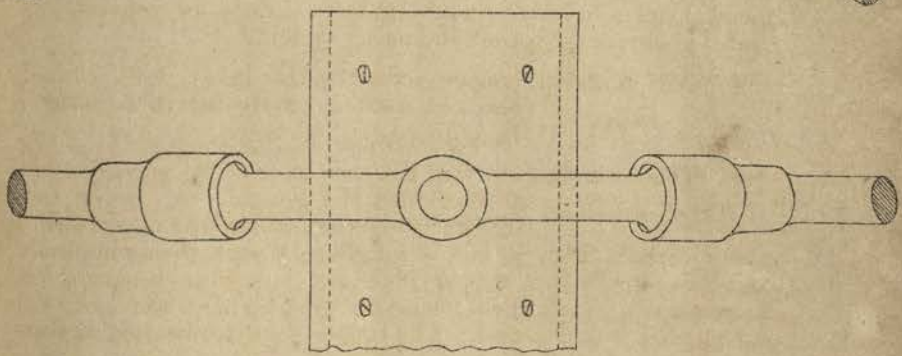
Scale = Half Size.

RIDGE CONNECTIONS FOR COPPER CONDUCTORS.

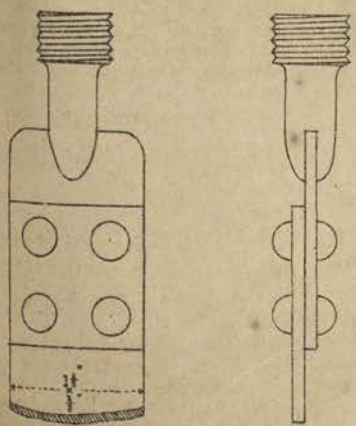
Connection of Conductor Point with Ridge and Rods.



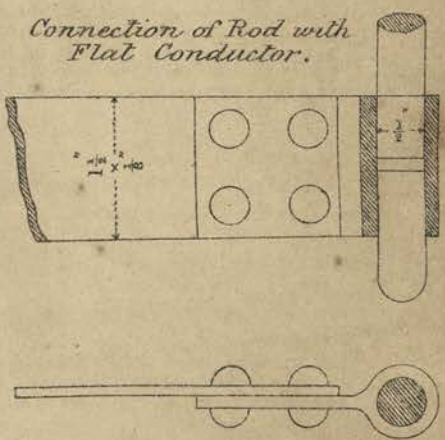
Plan.



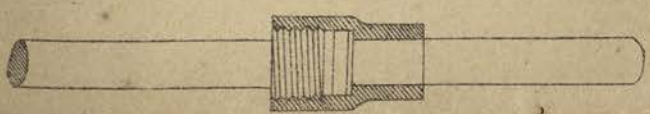
Connection of Flat with Rod Conductor.



Connection of Rod with Flat Conductor.



Connections for Rod.



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PROBABLE COST OF EXECUTING WORKS ACCORDING TO THE ABOVE SPECIFICATIONS.

C.—Double-tiled Roof Covering.

DOUBLE TILING ONLY.

Artificers, Labourers, and Materials for 100 Superficial Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Battens ...R. ft.	300	1 8 100 R.F.	4 8			
Nails for battens and rafters ... lbs.	6	1 0 6 lbs.	1 0			
Tiles ... No.	2200	4 0 1,000	8 13			
Sundries	...	... ...	0 4			
		Total Materials.	14 9			
Labour.						
Tile-turners ...	2	0 8 each.	1 0			
Women	3	0 2 do.	0 6			
Carpenter	1	0 12 do.	0 12			
Cooly	1	0 4 do.	0 4			
Bhistie	½	0 8 do.	0 2			
Sundries	...	... ...	0 3			
		Total Labour...	2 11			
Total for 100 Supl. Feet of double tiling and battens only			17 4		Total for 100 Supl. Feet of double tiling and battens only.	

CI.—Setting Hips and Ridges in Chunam.

Artificers, Labourers, and Materials for 100 Running Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Ridge Tiles... No.	150	4 0 100	6 0			
Lime ... C. F.	8	12 0 40 C. F.	2 6			
Sand ... C. F.	12	2 0 100 C. F.	0 4			
Sundries	...	... ...	0 3			
		Total Materials.	8 13			
Labour.						
Bricklayers... ...	4	0 10 each.	2 8			
Coolies	2	0 3 do.	0 6			
Women	2	0 2 do.	0 4			
Bhistie	¼	0 8 do.	0 2			
Tile-turner	½	0 8 do.	0 4			
Woman	½	0 2 do.	0 1			
Grinding chunam. C. F.	12	3 0 100 C. F.	0 6			
Sundries	...	... ...	0 4			
		Total Labour...	4 3			
Total for 100 R. F. of setting ridges and hips in chunam			13 0	Total for 100 R.F. of setting ridges and hips in chunam ...		

CII.—Setting double Eaves in Chunam.

Artificers, Labourers, and Materials for 100 Running Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Lime ... ...C. F.	8	12 0 40 C.F.	2 6			
Sand ... ...C. F.	12	2 0 100 C.F.	0 4			
Sundries	...	... ...	0 3			
		Total Materials.	2 13			
Labour.						
Bricklayers	3	0 10 each.	1 14			
Coolies	1	0 3 do.	0 3			
Women	3	0 2 do.	0 6			
Bhistie	¼	0 8 do.	0 2			
Grinding chunam ...	12	3 0 100 C.F.	0 6			
Sundries	...	... ...	0 4			
		Total Labour...	3 3			
Total for 100 R. F. of setting double eaves in chunam			6 0		Total for 100 R. F. of setting double eaves in chunam ...	

CIII.—Eaves Board.

Artificers, Labourers, and Materials for 100 Running Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Teak plank 6″ × ½″ R.F.	100	0 1 foot	6 4			
Screws 1½″ ...Dozen.	4	0 1 dozen	0 4			
Sundries	...	... ...	0 1			
		Total Materials.	6 9			
Labour.						
Carpenters	2	0 12 each	1 8			
Coolies	2	0 3 do.	0 6			
Sundries	...	... ...	0 1			
		Total Labour...	1 15			
Total for 100 R. F. of eaves board...			8 8	Total for 100 R.F. of eaves board ...		

CIV.—Double Tiled Roofing, xii feet Span. (Kingpost.)

(Ordinary Construction.)

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Timber in scantling in Bombay ... C.F.	16·67	3 0 C.F.	50 0			
Teak battens 2″ × ½″ R.F.	653	1 8 100 R.F.	9 13			
Iron-work in trusses, &c. ... lbs.	16	0 3 lbs.	3 0			
Nails ... lbs.	8	0 2 lbs.	1 0			
Sundries	...	... ...	0 12			
		Total Materials.	64 9			
Labour.						
On framed timber... C.F.	3·46	0 12 C.F.	2 9			
On wrought timber... C.F.	13·21	0 6 C.F.	4 15			
On fitting iron-work ...	...	... ...	1 0			
On fixing battens ... R.F.	623	0 6 100 R.F.	2 5			
Carriage of timber ... C.F.	21	0 4 C.F.	5 4			
Sundries	...	... ...	0 12			
		Total Labour ...	16 13			
Add.						
Double tiling ... S.F.	208	10 8 100 S.F.	21 13			
Setting ridges and hips ... ... R.F.	10	13 0 100 R.F.	1 5			
Setting double eaves R.F.	20	6 0 do.	1 3			
Eaves board 8″ × ¾″ ... R.F.	20	15 0 do.	3 0			
Total for 208 S.F. Roofing completed...			108 11			
Or for 100 S.F. Roofing completed...			52 4			

Construction.—Trusses 10 feet apart, purlins 4¾″ × 6¾″, common rafters 1¾″ × 2¾″, at 18″ inches, ridge pole 2½″ × 7½″, wall plate 4″ × 3½″, battens 2″ × ½″, double tiles, hips, ridges, and eaves set in chunam.

CV.—Double Tiled Roofing xiv feet Span. (Kingpost.)

(Ordinary Construction.)

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Timber in scantling in Bombay ... C.F.	20·08	3 0 C.F.	60 4			
Teak battens 2″×½″.. R.F.	722	1 8 100 R.F.	10 13			
Iron-work in trusses, &c. ... lbs.	19	0 3 lbs.	3 9			
Nails ... lbs.	10	0 2 lbs.	1 4			
Sundries	...	... ...	0 12			
		Total Materials.	76 10			
Labour.						
On framed timber ...C.F.	4·30	0 12 C.F.	3 4			
On wrought timber...C.F.	15·78	0 6 C.F.	5 15			
On fitting iron-work ...	...	... ...	1 2			
On fixing battens ...R.F.	689	0 6 100 R.F.	2 9			
Carriage of timber ...C.F.	25	0 4 C.F.	6 4			
Sundries	...	... ...	0 12			
		Total Labour ...	19 14			
Add.						
Double tiling ... S.F.	230	10 8 100 S.F.	24 2			
Setting ridges and hips ... ... R.F.	10	13 0 100 R.F.	1 5			
Setting double eaves R.F.	20	6 0 do.	1 3			
Eaves board 8″×¾″ R.F.	20	15 0 do.	3 0			
Total for 230 S.F. Roofing completed...			126 2			
Or for 100 S.F. Roofing completed...			54 13			

Construction.—Trusses 10 feet apart, purlins 5″×7″, common rafters 2″×3″, at 18″ inches, ridge pole 2½″×7¾″, wall plate 4″×3½″, battens 2″×½″, double tiles, hips, ridges, and eaves set in chunam.

CVI.—Double Tiled Roofing, xvi feet Span. (Kingpost.)

(Ordinary Construction.)

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Timber in scantling in Bombay ... C.F.	24·03	3 0 C.F.	72 1			
Teak battens 2″ × 1/2″ R.F.	797	1 8 100 R.F.	11 15			
Iron-work in trusses, &c. ... ... lbs.	23	0 3 lbs.	4 5			
Nails ... ... lbs.	12	0 2 lbs.	1 8			
Sundries	...	... ...	1 0			
		Total Materials.	90 13			
Labour.						
On framed timber ... C.F.	5·39	0 12 C.F.	4 1			
On wrought timber.. C.F.	18·64	0 6 C.F.	7 0			
On fitting iron-work ...	...	... ...	1 4			
On fixing battens R.F.	761	0 6 100 R.F.	2 14			
Carriage of timber... C.F.	30	0 4 C.F.	7 8			
Sundries	...	... ...	1 0			
		Total Labour ...	23 11			
Add.						
Double tiling ... S.F.	254	10 8 100 S.F.	26 11			
Setting ridges and hips ... R.F.	10	13 0 100 R.F.	1 5			
Setting double eaves. R.F.	20	6 0 do.	1 3			
Eaves board 8″ × 3/4″ R.F.	20	15 0 do.	3 0			
Total for 254 S.F. Roofing completed...			146 11			
Or for 100 S.F. Roofing completed...			57 12			

Construction.—Trusses 10 feet apart, purlins 5″×7 1/4″, common rafters 2 1/4″×3 1/4″, at 18″ inches, ridge pole 2 1/2″×8″, wall plate 4″×3 1/2″, battens 2″× 1/2″, double tiles, hips, ridges, and eaves set in chunam.

CVII.—Double Tiled Roofing, xviii feet Span. (Kingpost.)

(Ordinary Construction.)

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Timber in scantling in Bombay ... C.F.	29·06	3 0 C.F.	87 3	..		
Teak battens 2″×½″ R.F.	870	1 8 100 R.F.	13 1			
Iron-work in trusses, &c. ... ... lbs.	27	0 3 lbs.	5 1			
Nails ... ... lbs.	14	0 2 lbs.	1 12			
Sundries	...	... ...	1 2			
		Total Materials.	108 3			
Labour.						
On framed timber ...C.F.	6·93	0 12 C.F.	5 3			
On wrought timber...C.F.	22·13	0 6 C.F.	8 5			
On fitting iron-work ...	..	... ...	1 8			
On fixing battens ...R.F.	830	0 6 100 R.F.	3 2			
Carriage of timber ...C.F.	35	0 4 C.F.	8 12			
Sundries	...	... ...	1 2			
		Total Labour...	28 0			
Add.						
Double tiling ... S.F.	277	10 8 100 S.F.	29 1			
Setting ridges and hips ... ... R.F.	10	13 0 100 R.F.	1 5			
Setting double eaves, R.F.	20	6 0 do.	1 3			
Eaves board 8″×¾″...R.F.	20	15 0 do.	3 0			
Total for 277 S.F. Roofing completed...			170 12			
Or for 100 S.F. Roofing completed...			61 10			

Construction.—Trusses 10 feet apart, purlins $5\frac{1}{4}'' \times 7\frac{1}{4}''$, common rafters $2\frac{1}{2}'' \times 3\frac{1}{2}''$, at 18″ inches, ridge pole $2\frac{1}{2}'' \times 8\frac{1}{2}''$, wall plate $4'' \times 3\frac{1}{2}''$, battens $2'' \times \frac{1}{2}''$, double tiles, hips, ridges, and eaves set in chunam.

CVIII.—Double Tiled Roofing, xx feet Span. (Kingpost.)

(Ordinary Construction.)

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Timber in scantling in Bombay ... C.F.	32·90	3 0 C.F.	98 11			
Teak battens 2″×½″ R.F.	942	1 8 100 R.F.	14 2			
Iron-work in trusses, &c. ... ... lbs.	32	0 3 lbs.	6 0			
Nails ... ... lbs.	16	0 2 lbs.	2 0			
Sundries	...	... ...	1 4			
		Total Materials.	122 1			
Labour.						
On framed timber ... C.F.	8·37	0 12 C.F.	6 4			
On wrought timber... C.F.	24·53	0 6 C.F.	9 3			
On fitting iron-work ...	...	... ...	1 12			
On fixing battens R.F.	899	0 6 100 R.F.	3 6			
Carriage of timber C.F.	39	0 4 C.F.	9 12			
Sundries	...	... ...	1 4			
		Total Labour ...	31 9			
Add.						
Double tiling ... S.F.	300	10 8 100 S.F.	31 8			
Setting ridges and hips ... ... R.F.	10	13 0 100 R.F.	1 5			
Setting double eaves. R.F.	20	6 0 do.	1 3			
Eaves board 8″×¾″ R.F.	20	15 0 do.	3 0			
Total for 300 S.F. Roofing completed...			190 10			
Or for 100 S.F. Roofing completed...			63 9			

Construction.—Trusses 10 feet apart, purlins 5¼″×7½″, common rafters 2½″×3¾″, at 18″ inches, ridge pole 2½″× 8¾″, wall plate 4″×3½″, battens 2″×½″, double tiles, hips, ridges, and eaves set in chunam.

CIX.—Double Tiled Roofing, xxii feet Span. (Kingpost.)

(Ordinary Construction.)

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Timber in scantling in Bombay ...C.F.	39·56	3 0 C. F.	118 11			
Teak battens 2″×½R.F.	1013	1 8 100 R. F.	15 3			
Iron-work in trusses &c. ... ... lbs.	37	0 3 lbs.	6 15			
Nails ... ... lbs.	19	0 2 lbs.	2 6			
Sundries	...	... ...	1 4			
		Total Materials	144 7			
Labour.						
On framed timber. C.F.	10·30	0 12 C. F.	7 12			
On wrought timber. C.F.	29·26	0 6 C. F.	11 0			
On fitting iron-work ...	...	... ...	2 0			
On fixing battens R.F.	967	0 6 100 R. F.	3 10			
Carriage of timber. C.F.	47	0 4 C. F.	11 12			
Sundries	...	... ...	1 4			
		Total Labour...	87 6			
Add.						
Double tiling ...S.F.	323	10 8 100 S. F.	33 15			
Setting ridges and hips ... ...R.F.	10	13 0 100 R. F.	1 5			
Setting double eaves R.F.	20	6 0 do.	1 3			
Eaves board 8″×¾″R.F.	20	15 0 do.	3 0			
Total for 323 S.F. Roofing completed ...			221 4			
Or for 100 S. F. Roofing completed ...			68 8			

Construction.—Trusses 10 feet apart, purlins 5½″×7½″, common rafters 2½″×4″, at 18″ inches, ridge pole 2½″×9½″, wall plate 4″×3½″, battens 2″×½″, double tiles, hips ridges, and eaves set in chunam.

CX.—Double Tiled Roofing, xxiv feet Span. (Queenpost).

(Ordinary Construction.)

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Timber in scantling in Bombay ...C. F	38·98	3 0 C. F.	116 15			
Teakbattens.2″×½″R.F.	1086	1 8 100 R. F.	16 5			
Iron-work in trusses, &c. ... ... lbs.	37	0 3 lbs.	6 15			
Nails ... ... lbs.	19	0 2 lbs.	2 6			
Sundries	...	... ...	1 8			
		Total Materials.	144 1			
Labour.						
On framed timber, C.F.	11·83	0 12 C. F.	8 14			
On wrought timber, C.F.	27·15	0 6 C. F.	10 3			
On fitting iron-work ...	...	... ...	2 4			
On fixing battens, R. F.	1036	0 6 100 R. F.	3 14			
Carriage of timber, C.F.	47	0 4 C. F.	11 12			
Sundries	...	... ...	1 8			
		Total Labour...	38 7			
Add.						
Double tiling ... S. F.	346	10 8 100 S. F.	36 5			
Setting ridges and hips ... ... R. F.	10	13 0 100 R. F.	1 5			
Setting double eaves R. F.	20	6 0 do.	1 3			
Eaves board 8″×¾″R. F.	20	15 0 do.	3 0			
Total for 346 S. F. Roofing completed ...			224 5			
Or for 100 S. F. Roofing completed ...			64 13			

Construction.—Trusses 10 feet apart, purlins 5″×7″, common rafters 2½″×3″, at 18″ inches, ridge pole 2½″×7¾″, wall plate 4″×3½″, battens 2″×½″, double tiles, hips, ridges, and eaves set in chunam.

CXI.—Double Tiled Roofing, xxvi feet Span. (Queenpost.)

(Ordinary Construction.)

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount.
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Timber in scantling in Bombay ... C. F.	42·71	3 0 C. F.	128 2			
Teak battens 2″×½″R.F.	1158	1 8 100 R. F.	17 6			
Iron-work in trusses, &c. ... ... lbs.	43	0 3 lbs.	8 1			
Nails ... ... lbs.	22	0 2 lbs.	2 12			
Sundri s	...	... ...	1 8			
		Total Materials.	157 13			
Labour.						
On framed timber. C.F.	13·04	0 12 C. F.	9 12			
Onwrought timber C.F.	29·67	0 6 C. F.	11 2			
On fitting iron-work ...	...	... ...	2 8			
On fixing battens R. F.	1105	0 6 100 R. F.	4 2			
Carriage of timber. C.F.	51	0 4 C. F.	12 12			
Sundries	...	... ...	1 8			
		Total Labour...	41 12			
Add.						
Double tiling ... S. F.	369	10 8 100 S. F.	38 12			
Setting ridges and hips ... ... R. F.	10	13 0 100 R. F.	1 5			
Setting double eaves R. F.	20	6 0 do.	1 3			
Eaves board 8″×⅜″R. F.	20	15 0 do.	3 0			
Total for 369 S. F. Roofing completed ...			243 13			
Or for 100 S. F. Roofing completed ...			66 1			

Construction.—Trusses 10 feet apart, purlins 5″×7½″, common rafters 2½″×3½″, at 18″ inches, ridge pole 2½″×8″, wall plate 4″×3½″, battens 2″×½″, double tiles, hips, ridges, and eaves set in chunam.

CXII.—Double Tiled Roofing, xxviii feet Span. (Queenpost.)

(Ordinary Construction.)

Materials and Labour.	No. or quantity.	Rate,	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Timber in scantling in Bombay .:. C. F.	50·19	3 0 C. F.	150 9			
Teak battens 2″×½″R.F.	1234	1 8 100 R. F.	18 8			
Iron-work in trusses &c. ... ... lbs.	47	0 3 lbs.	8 13			
Nails ... ... lbs.	24	0 2 lbs.	3 0			
Sundries	...	— ...	2 0			
		Total Materials.	182 14			
Labour.						
On framed timber C.F.	15·37	0 12 C. F.	11 8			
On wrought timber C.F.	34·82	0 6 C. F.	13 1			
On fitting iron-work ...	...	... ...	2 12			
On fixing battens R.F.	1177	0 6 100 R. F.	4 7			
Carriage of timber C.F.	59	0 4 C. F.	14 12			
Sundries	...	... ...	2 0			
		Total Labour...	48 8			
Add.						
Double tiling ... S. F.	393	10 8 100 S. F.	41 4			
Setting ridges and hips ... ... R. F.	10	13 0 100 R. F.	1 5			
Setting double eaves R. F.	20	6 0 do.	1 3			
Eaves board 8″×¾″ R.F.	20	15 0 do.	3 0			
Total for 393 S. F. Roofing completed ...			278 2			
Or for 100 S. F. Roofing completed ...			70 12			

Construction.—Trusses 10 feet apart, purlins 5¼″×7½″, common rafters 2½″×3½″, at 18″ inches, ridge pole 2½″×8½″, wall plate 4″×3½″, battens 2″×½″, double tiles, hips, ridges, and eaves set in chunam.

CXIII.—Double Tiled Roofing, xxx feet Span. (Queenpost.)

(Ordinary Construction.)

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Timber in scantling in Bombay ... C.F.	55·34	3 0 C.F.	166 0			
Teak battens 2″×½″R.F.	1306	1 8 100 R. F.	19 9			
Iron-work in trusses, &c. ... ... lbs.	54	0 3 lbs.	10 2			
Nails ... ... lbs.	27	0 2 lbs.	3 6			
Sundries	...	.. ...	2 0			
		Total Materials .	201 1			
Labour.						
On framed timber C.F.	17·66	0 12 C.F.	13 4			
On wrought timber C.F	37·68	0 6 C.F	14 2			
On fitting iron-work...	...	... ...	3 0			
On fixing battens R.F.	1246	0 6 100 R.F.	4 11			
Carriage of timber C.F.	64	0 4 C.F.	16 0			
Sundries	...	... ...	2 0			
		Total Labour...	53 1			
Add.						
Double tiling .... S.F.	416	10 8 100 S.F.	43 11			
Setting ridges and hips ... ... R.F.	10	13 0 100 R.F.	1 5			
Setting double eaves R.F.	20	6 0 do.	1 3			
Eaves board 8″×¾″R.F.	20	15 0 do.	3 0			
Total for 416 S.F. Roofing completed...			303 5			
Or for 100 S. F. Roofing completed ...			72 15			

Construction.—Trusses 10 feet apart, purlins 5½″×7½″, common rafters 2½″×3¾″, at 18″ inches, ridge pole 2½″×8¾″, wall plate 4″×3½″, battens 2″×½″, double tiles, hips, ridges and eaves set in chunam.

CXIV.—Double Tiled Verandah Roofing, vi feet Span.

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Timber in scantling in Bombay ... C.F.	7·94	3 0 C.F.	23 13			
Teak battens 2″ × ½″ R.F.	272	1 8 100 R.F.	4 1			
Nails ... ... lbs.	4	0 2 lbs.	0 8			
Sundries	...	... ...	0 6			
		Total Materials.	28 12			
Labour.						
On wrought timber C.F.	7·94	0 6 C.F.	3 0			
On fixing battens R.F.	259	0 6 100 R.F.	1 0			
Carriage of timber C.F.	10	0 4 C.F.	2 8			
Sundries	...	... ...	0 6			
		Total Labour...	6 14			
Add.						
Double tiling ... S.F.	87	10 8 100 S.F.	9 2			
Setting double eaves R.F.	10	6 0 100 R.F.	0 10			
Eaves board 8″ × ¾″ R.F.	10	15 0 do.	1 8			
Total for 87 S.F. Roofing completed...			46 14			
Or for 100 S.F. Roofing completed ...			53 14			

Construction.—Post plate 4″ × 7″, common rafters 2½″ × 3¾″, at 18″ inches, wall plate 3½″ × 4″, battens 2″ × ½″, double tiles, and eaves set in chunam.

CXV.—Double Tiled Verandah Roofing, viii feet Span.

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Timber in scantling in Bombay ... C.F.	10·63	3 0 C.F.	31 14			
Teak battens 2″ × ½″ R.F.	345	1 8 100 R.F.	5 3			
Nails ... ... lbs.	7	0 2 lbs.	0 14			
Sundries	...	... ...	0 8			
		Total Materials.	38 7			
Labour.						
On wrought timber C.F.	10·63	0 6 C.F.	4 0			
On fixing battens R.F.	329	0 6 100 R.F.	1 4			
Carriage of timber C.F.	13	0 4 C.F.	3 4			
Sundries	...	... ...	0 8			
		Total Labour ...	9 0			
Add.						
Double tiling ... S.F.	110	10 8 100 S.F.	11 9			
Setting double eaves R.F.	10	6 0 100 R.F.	0 10			
Eaves board 8″ × ¾″ R.F.	10	15 0 do.	1 8			
Total for 110 S.F. Roofing completed...			61 2			
Or for 100 S.F. Roofing completed ..			55 9			

Construction.—Principals 3½″ × 7½″, at 10 feet apart, post plate 4½″ × 6¾″, purlins 4½″ × 7″, common rafters 1¾″ × 2¾″, at 18″ inches, wall plate 3½″ × 4″, battens 2″ × ¼″, double tiles and eaves set in chunam.

CXVI.—Double Tiled Verandah Roofing, x feet Span.

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Timber in scantling in Bombay ... C.F.	14·61	3 0 C.F.	43 13			
Teak battens 2″ × ½″ R.F.	418	1 8 100 R.F.	6 4			
Nails ... ... lbs.	8	0 2 lbs.	1 0			
Sundries	....	... ...	0 8			
		Total Materials.	51 9			
Labour.						
On wrought timber C.F.	14·61	0 6 C.F.	5 7			
On fixing battens R.F.	398	0 6 100 R.F.	1 8			
Carriage of timber C.F.	18	0 4 C.F.	4 8			
Sundries	...	... ...	0 8			
		Total Labour...	11 15			
Add.						
Double tiling ... S.F.	132	10 8 100 S.F.	13 14			
Setting double eaves R.F.	10	6 0 100 R.F.	0 10			
Eaves board 8″ × ¾″ R.F.	10	15 0 do.	1 8			
Total for 132 S.F. Roofing completed ...			79 8			
Or for 100 S. F. Roofing completed...			60 4			

Construction.—Principals 3¾″ × 9″ at 10 feet apart, post plate 4½″ × 7″, purlins 4½″ × 7½″, common rafters 2¼″ × 3¼″, at 18″ inches, wall plate 3½″ × 4″, battens 2″ × ½″, double tiles and eaves set in chunam.

CXVII.—Double Tiled Roofing, xii feet Span (Kingpost).

(Purlin Rafter Construction.)

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Timber in scantling in Bombay ... C.F.	20·59	3 0 C.F.	61 12			
Iron-work in trusses, &c. ... ... lbs.	14	0 3 lbs.	2 10			
Nails ... ... lbs.	7	0 2 lbs.	0 14			
Teak planking 6″×¾″ S.F.	229	17 0 100	38 15			
Screws 1¼″ ... dozen	23	0 2 dozen	2 14			
Sundries	...	... ...	0 12			
		Total Materials.	107 13			
Labour.						
On framed timber C.F.	3·46	0 12 C.F.	2 9			
On wrought timber C.F.	17·13	0 6 C.F.	6 7			
On fitting iron-work ...	...	... ...	1 0			
On laying planking S.F.	208	2 4 100	4 11			
Carriage of timber C.F.	35	0 4 C.F.	8 12			
Sundries	...	... ...	0 12			
		Total Labour...	24 3			
Add.						
Double tiling ... S.F.	208	10 8 100	21 13			
Setting ridges and hips... ... R.F.	10	13 0 100	1 5			
Setting double eaves R.F.	20	6 0 100	1 3			
Eaves board 8″×¾″ R.F.	20	15 0 100	3 0			
Total for 208 S.F. Roofing completed ...			159 5			
Or for 100 S.F. Roofing completed ...			76 9			

Construction.—Trusses 10 feet apart, purlin rafters 4½″×6½″ at 3 feet apart, ridge pole 3″×7¼″, wall plate 4″×3½″, planking ⅞″ tongued and grooved, double tiled, hips, ridges and eaves set in chunam.

CXVIII.—Double Tiled Roofing, xiv feet Span (Kingpost).

(Purlin Rafter Construction.)

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Timber in scantling in Bombay (Teak) C.F.	21·43	3 0 C.F.	64 5			
Iron-work in trusses, &c. ... ... lbs.	17	0 3 lbs.	3 3			
Nails ... ... lbs.	9	0 2 lbs.	1 2			
Teak planking 6″ × ¾″ S.F.	253	17 0 100	43 0			
Screws 1¼″ ... doz.	25	0 2 doz.	3 2			
Sundries	...	... ...	0 12			
		Total Materials.	115 8			
Labour.						
On framed timber C.F.	4·30	0 12 C.F.	3 4			
On wrought timber C.F.	17·13	0 4 C.F.	6 7			
On fitting iron-work ...	...	... ...	1 2			
On laying planking S.F.	230	2 4 100	5 3			
Carriage of timber C.F.	37	0 4 C.F.	9 4			
Sundries	...	... ...	0 12			
		Total Labour ...	26 0			
Add.						
Double tiling ... S.F.	230	10 8 100	24 2			
Setting ridges and hips ... ... R.F.	10	13 0 100	1 5			
Setting double eaves ... R.F.	20	6 0 100	1 3			
Eaves board 8″ × ¾″ R.F.	20	15 0 100	3 0			
Total for 230 S·F. Roofing completed ...			171 2			
Or for 100 S.F. Roofing completed ...			74 6			

Construction.—Trusses 10 feet apart, purlin rafters 4½″ × 6¼″ at 3 feet apart, ridge pole 3″×7¼″, wall plate 4″×3½″, planking ¾″ tongued and grooved, double tiled, hips, ridges and eaves set in chunam.

CXIX.—Double Tiled Roofing, xvi feet Span (Kingpost).

(Purlin Rafter Construction.)

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Timber in scantling in Bombay (Teak). C.F.	22·52	3 0 C.F.	67 9			
Iron-work in trusses, &c. ... ... lbs.	19	0 3 lbs	3 9			
Nails ... .. lbs.	10	0 2 lbs.	1 4			
Teak planking 6″ × ¾″ S.F.	279	17 0 100	47 7			
Screws 1¼″ ... doz.	28	0 2 dozen	3 8			
Sundries	...	.....	1 0			
		Total Materials.	124 5			
Labour.						
On framed timber C.F.	5·39	0 12 C.F.	4 1			
On wrought timber ... C.F.	17·13	0 6 C.F.	6 7			
On fitting iron-work...	...	.....	1 4			
On laying planking S.F.	254	2 4 100	5 11			
Carriage of timber C.F.	40	0 4 C.F.	10 0			
Sundries	...	.....	1 0			
		Total Labour ...	28 7			
Add.						
Double tiling ... S.F.	254	10 8 100	26 11			
Setting ridges and hips ... R.F.	10	13 0 100	1 5			
Setting double eaves ... R.F.	20	6 0 100	1 3			
Eaves board 8″ × ¾″ R.F	20	15 0 100	3 0			
Total for 254 S.F. Roofing completed...			184 15			
Or for 100 S. F. Roofing completed...			72 13			

Construction.—Trusses 10 feet apart, purlin rafters 4½″ × 6½″ at 3 feet apart, ridge pole 3″ × 7¼″, wall plate 4″ × 3½″, planking ¾″ tongued and grooved, double tiled, hips, ridges and eaves set in chunam.

CXX.—Double Tiled Roofing, xviii feet Span (Kingpost).

(Purlin Rafter Construction.)

Materials and Labour.	No. or quantity.	Rate.			Amount	No. or quantity.	Rate.			Amount
		Rs.	a.	Per	Rs. a.		Rs.	a.	p.	Rs. a.
Materials.										
Timber in scantling in Bombay (Teak) ..	C.F. 27·97	3	0	C.F.	83 15					
Iron-work in trusses, &c.	lbs. 23	0	3	lbs.	4 5					
Nails	lbs. 12	0	2	lbs.	1 8					
Teak planking 6″ × ¾″	S.F. 304	17	0	100	51 11					
Screws 1¼″ ...	doz. 30	0	2	doz.	3 12					
Sundries	...		.....		1 2					
		Total Materials.			146 5					
Labour.										
On framed timber.	C.F. 6·93	0	12	C.F.	5 3					
On wrought timber	C.F. 21·04	0	6	C.F.	7 14					
On fitting iron-work ...	...		.....		1 8					
On laying planking	S.F. 277	2	4	100	6 4					
Carriage of timber.	C.F. 47	0	4	C.F.	11 12					
Sundries	...		.....		1 2					
		Total Labour ...			33 11					
Add.										
Double tiling ...	S.F. 277	10	8	100	29 1					
Setting ridges and hips	R.F. 10	13	0	100	1 5					
Setting double eaves	R.F. 20	6	0	100	1 3					
Eaves board 8″ × ¾″	R.F. 20	15	0	100	3 0					
Total for 277 S.F. Roofing completed...					214 9					
Or for 100 S.F. Roofing completed...					77 7					

Construction.—Trusses 10 feet apart, purlin rafters 4½″ × 6¼″ at 3 feet apart, ridge pole 3″ × 7¼″, wall plate 4″ × 3½″, planking ¾″ tongued and grooved, double tiled, hips, ridges and eaves set in chunam.

CXXI.—Double Tiled Roofing, xx feet Span (Kingpost).

(Purlin Rafter Construction.)

Materials and Labour.	No. or quantity.	Rate.			Amount		No. or quantity.	Rate.			Amount	
		Rs.	a.	Per	Rs.	a.		Rs.	a.	Per	Rs.	a.
Materials.												
Timber in scantling in Bombay (Teak).	C.F. 29·41	3	0	C.F.	88	4						
Iron-work in trusses, &c.	lbs. 27	0	3	lbs.	5	1						
Nails	lbs. 14	0	2	lbs.	1	12						
Teak planking 6″ × ¾″	S.F. 330	17	0	100	56	2						
Screws 1¼″	dozen 33	0	2	doz.	4	2						
Sundries	...		.....		1	4						
		Total Materials.			156	9						
Labour.												
On framed timber.	C.F. 8·37	0	12	C.F.	6	4						
On wrought timber	C.F. 21·04	0	6	C.F.	7	14						
On fitting iron-work...	...		.....		1	12						
On laying planking	S.F. 300	2	4	100	6	12						
Carriage of timber.	C.F. 50	0	4	C.F.	12	8						
Sundries	...		.....		1	4						
		Total Labour ...			36	6						
Add.												
Double tiling ...	S.F. 300	10	8	100	31	8						
Setting ridges and hips	R.F. 10	13	0	100	1	5						
Setting double eaves ...	R.F. 20	6	0	100	1	3						
Eaves board 8″ × ¾″	R.F. 20	15	0	100	3	0						
Total for 300 S.F. Roofing completed...					229	15						
Or for 100 S.F. Roofing completed...					76	10						

Construction.—Trusses 10 feet apart, purlin rafters 4½″ × 6¼″ at 3 feet apart, ridge pole 3″ × 7¼″, wall plate 4″ × 3½″, planking ¾″ tongued and grooved, double tiled, hips, ridges and eaves set in chunam.

CXXII.—Double Tiled Roofing, xxii feet Span (Kingpost).

(Purlin Rafter Construction.)

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Timber in scantling in Bombay (Teak)..C.F.	35·24	3 0 C.F.	105 12			
Iron-work in trusses,&c. lbs.	30	0 3 lbs.	5 10			
Nails ... ... lbs.	15	0 2 lbs.	1 14			
Teak planking 6″×¾″ ... ... S.F.	355	17 0 100	60 6			
Screws 1¼″ ... dozen	36	0 2 dozen	4 8			
Sundries	...	.....	1 4			
		Total Materials.	179 6			
Labour..						
On framed timber. C.F	10·30	0 12 C.F.	7 12			
On wrought timber C.F	24·94	0 6 C.F.	9 6			
On fitting iron-work ...	...	.....	2 0			
On laying planking S.F.	323	2 4 100	7 4			
Carriage of timber. C.F.	57	0 4 C.F.	14 4			
Sundries	...	.....	1 4			
		Total Labour ...	41 14			
Add.						
Double tiling ... S.F.	323	10 8 100	33 15			
Setting ridges and hips ... ...R.F.	10	13 0 100	1 5			
Setting double eaves ... ...R.F.	20	6 0 100	1 3			
Eaves board 8″×¾″R.F.	20	15 0 100	3 0			
Total for 323 S.F. Roofing completed...			260 11			
Or for 100 S.F. Roofing completed...			80 11			

Construction.—Trusses 10 feet apart, purlin rafters 4½″×6¼″ at 3 feet apart, ridge pole 3″×7¼″, wall plate 4″×3½″, planking ¾″, tongued and grooved double tiled, hips, ridges and eaves set in chunam.

CXXIII.—Galvanized Corrugated Iron Roof Covering.

How to find out a rate for 2,100 S.F. of roofing. Find out the number and weight of sheets of the different sizes required. Say they are as follows :—

100 Sheets, 6′×2′ 3″ 20 gauge, weight = 2,358 lbs.
100 do. 7′×2′ 3″ do. do. = 2,821 lbs.

Total weight of galvanized iron sheet for 2,100 square feet | Total ...5,179 lbs. or 45·34 cwts.

Labourers and Materials for 2,100 Square Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per.	Rs. a.		Rs. a. Per	
Materials.						
Galvanized Corrugated iron 20 B.W.G. in Bombay ... Cwt.	45·34	10 8 Cwt.	476 1			
Ridge Capping R.F.	84	0 9 R.F.	47 4			
Other materials, such as washers, screws, &c. (as hereafter shown) S.F.	2,100	3 0 100 S.F.	63 0			
		Total Materials.	586 5			
Labour						
Carriage from Bombay ... ...Cwt.	45·34	2 8 Cwt.	113 6			
Rivetting and fixing (as hereafter shown) S.F.	2,100	4 0 100 S.F.	84 0			
Cutting sheets Cwt.	...	.....	8 8			
Fixing ridge (as hereafter shown) R.F.	84	5 0 100 R.F.	4 3			
Sundries	...	.....	10 0			
		Total Labour ...	220 1			
Total for 2,100 S. F. of Roof Covering...			806 6		Total for 2,100 S.F. of Roof Covering.	
Or for 100 S.F. of do.			38 6		Or for 100 S.F. of do	

CXXIV.—Rivetting and fixing Corrugated Iron Sheets.

Artificers, Labourers and Materials for 100 Superficial Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Lead-washers lbs.	1	0 6 lbs.	0 6			
G. I. rivets do.	1½	0 4 do.	0 6			
G. I. screws do.	1	0 6 do.	0 6			
Iron for bolts, &c. do.	3	0 2 do.	0 6			
Charcoal ... do.	30	1 0 80 lbs.	0 6			
Sundries	...	.....	0 2			
		Total Materials.	2 0			
Labour for rivetting.						
Carpenter	1¾	0 12 do.	1 5			
Coolies	1¾	0 3 do.	0 5			
Sundries	...	.....	0 1			
Labour for fixing, including fastening to purlins, &c., and making bolts.						
Carpenters	1½	0 12 do.	1 2			
Coolies...	1½	0 3 do.	0 5			
Smith	¾	0 12 do.	0 9			
Bellows-boy	¾	0 4 do.	0 3			
Sundries	...	.....	0 2			
		Total Labour...	4 0			
Total for rivetting and fixing 100 S.F. corrugated iron sheets			6 0		Total for rivetting and fixing corrugated iron sheets.	

CXXV.—Fixing Galvanized Iron Ridge.

Artificers and Labourers for 100 Running Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Labour.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Carpenters	5	0 12 each.	3 12			
Coolies...	5	0 3 do.	0 15			
Sundries		.....	0 5			
Total for fixing 100 R. feet of ridge ...			5 0	Total for fixing 100 R. feet of ridge ...		

Note.—Molesworth says $\frac{1}{10}$ weight to be added for lappage. This is not sufficient, and for accurate estimating a plan of each roof should be worked out, showing the exact number of sheets of each length required. The Table on the following page will give some idea of how the sheets can best be utilized for different spans, and percentage for lappage, the sheets being 2'3" in width.

Weight of Galvanized Corrugated Iron.

No. 14 gauge weighs about 300 lbs. per 100 sq. ft.
16 " " " 260 "
18 " " " 236 "
20 " " " 190 "
22 " " " 150 "
24 " " " 130 "

Corrugated Iron Roofing for various spans, the sheets having a vertical and horizontal overlap of 6″ and their width being 2′ 3.″

Span.	Thickness of wall.	Horizontal Projection of Eaves.	Length of side.	No. and size of sheets in one side x.	Total percentage of sheet area over area of roof.	Remarks.
12	1·5	1·25	10·0	No. 1 of 7′ and ½ of 7′	35 per cent	The projection of eaves is reduced to suit the sheets.
14	1·5	1·5	11·5	No. 1 of 8′ and ½ of 8.′	34	Do do.
16	1·5	1·37	12·5	1 of 7′ and 1 of 6′ ...	33·71	Do. do.
18	1·5	1·25	13·5	2 of 7′	33	Do. do.
20	1·5	1·11	14·5	1 of 8′ and 1 of 7′...	33	Do. do.
		1·97	15·5	2 of 8′	32·71	Do. increased.
22	1·5	1·87	16·5	2 of 7′ and ½ of 7′...	36	Do. do.
24	1·5	1·67	17·5	1 of 8′, 1 of 7′ and ½ of 7′	36	Do. do.
26	2·0	1·5	19·0	2 of 8′ and ½ of 8′...	36·34	
28	2·0	1·33	20·0	1 of 8′, 1 of 7, 1 of 6 or 3 of 7′	35	Do. reduced.
30	2·0	1·20	21·0	1 of 8′ and 2 of 7′...	34·69	Do. do.
32	2·0	1·56	22·5	2 of 7′, 1 of 6′ and ½ of 8″.	37·15	Do. increased.
34	2·0	1·43	23·5	3 of 7′, and ½ of 8′...	36·78	Do. reduced.
36	2·0	1·23	24·5	1 of 8′, 2 of 7′ and ½ of 8″.	36·47	Do. do.
38	2·0	1·60	26	3 of 8′ and ½ of 7 ...	36	Do. increased
40	2·0	1·96	27·5	1 of 8′ and 3 of 7′...	35·58	Do. do.

CXXVI.—Corrugated Iron Roofing, xii feet Span (Kingpost).

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Timber in scantling in Bombay (Teak) C. F.	14·3	3 0 C.F.	42 14			
Iron-work in trusses ... ... lbs.	16	0 3 lb.	3 0			
Nails for purlins, &c. ... ... lbs.	8	0 2 lb.	1 0			
Teak planking 6″ × ½″ ... ... S.F.	154	14 0 100	21 9			
Screws 1¼″ ... doz.	15	0 2 doz.	1 14			
Galvanized Corrugated iron in Bombay 20 B.W.G. ...Cwt.	4¾	10 8 Cwt.	49 14			
Ridge Capping ...R.F.	10	0 9 R.F.	5 10			
Galvanized iron Guttering ... ...R.F.	20	0 14 R.F.	17 8			
Washers, rivets, screws, &c. ...S.F.	210	3 0 100	6 5			
Sundries		.....	1 8			
		Total Materials.	151 2			
Labour.			2 10			
On framed timber. C.F.	3·48	0 12 C.F.	4 1			
On wrought timber C.F.	10·8	0 6 C.F.				
On fitting iron-work....	...	.....	1 0			
On laying planking S.F.	140	2 4 100	3 2			
Rivetting and fixing sheets ... S.F.	210	4 0 100	8 6			
Cutting sheets ...Cwt.	4¾	0 3 Cwt.	0 14			
Fixing Ridge ...R.F.	10	5 0 100	0 8			
Fixing Gutters ... R.F.	20	3 6 100	0 11			
Carriage of iron sheets ... ...Cwt.	4¾	2 8 Cwt.	11 14			
Carriage of timber ... ... C.F.	21	0 4 C.F.	5 4			
Sundries		.....	0 8			
		Total Labour...	38 14			
Add.						
Galvanized iron wire netting ... S.F.	10	35 4 100	3 8			
Total for 210 S.F. Roofing completed ...			193 8			
Or for 100 S.F. Roofing completed ...			92 2			

Construction.—Trusses 10 feet apart, purlins 4″×5½″ at 3 feet apart, teak planking ½″ screwed to underside of purlins, ridge pole 2½″×7″, wall plate 4″×3½″, covering of Galvanized Corrugated iron 20 B.W.G., wire netting ¾″ Mesh under ridge pole.

CXXVII.—Corrugated Iron Roofing, xiv feet Span (Kingpost).

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Timber in scantling in Bombay (Teak) .C.F.	18·2	3 0 C.F.	54 10			
Iron-work in trusses ... ... lbs.	20	0 3 lb.	3 12			
Nails for purlins, &c.lbs.	10	0 2 lb.	1 4			
Teak planking 6″ × ½″... ... S.F.	182	14 0 100	25 8			
Screws 1¼″ ... doz.	18	0 2 dozen	2 4			
Galvanized Corrugated iron in Bombay 20 B.W.G. ... Cwt.	5¼	10 8 Cwt.	55 2			
Ridge Capping ...R.F.	10	0 9 R.F.	5 10			
Galvanized iron Guttering ...R.F.	20	0 14 R.F.	17 8			
Washers, rivets, screws, &c. ... S.F.	230	3 0 100	6 14			
Sundries		.....	1 12			
		Total Materials.	174 4			
Labour.						
On framed timber. C.F.	4·19	0 12 C.F.	3 2			
On wrought timber C.F.	14	0 6 C.F.	5 4			
On fitting iron-work ...	...	.....	1 4			
On laying planking S.F.	165	2 4 100	3 11			
Rivetting and fixing sheets ... ...S.F.	230	4 0 100	9 3			
Cutting sheets .. Cwt.	5¼	0 3 Cwt.	1 0			
Fixing Ridge ...R.F.	10	5 0 100	0 8			
Fixing Gutters ...R.F.	20	3 6 100	0 11			
Carriage of iron sheets ... ... Cwt.	5¼	2 8 Cwt.	13 2			
Carriage of timber.C.F.	26	0 4 C.F.	6 8			
Sundries	...	.....	0 8			
		Total Labour...	44 13			
Add.						
Galvanized iron wire netting ...S.F.	10	35 4 100	3 8			
Total for 230 S.F. Roofing completed ...			222 9			
Or for 100 S.F. Roofing completed ...			96 12			

Construction.—Trusses 10 feet apart, purlins 4″×5⅝″ at 3 feet apart, teak planking ½″ screwed to under side of purlins, ridge pole 2½″×7″, wall plate 4″×3½″, covering of Galvanized Corrugated iron 20 B. W. G., wire netting ⅜″ Mesh under ridge pole.

CXXVIII.—Corrugated Iron Roofing, xvi feet Span (Kingpost).

Materials and Labour.	No. or quantity.	Rate.			Amount		No. or quantity.	Rate.			Amount
Materials.		Rs.	a.	Per	Rs.	a.		Rs.	a.	Per	Rs. a.
Timber in scantling in Bombay (Teak).. C.F.	19·2	3	0	C.F.	57	10					
Iron-work in trusses ... ... lbs	22	0	3	lb.	4	2					
Nails for purlins,&c. lbs.	11	0	2	lb.	1	6					
Teak planking 6″ × $\frac{1}{2}$″ ... ... S.F.	204	14	0	100	28	9					
Screws 1$\frac{1}{4}$″ ... doz.	20	0	2	doz.	2	8					
Galvanized Corrugated iron in Bombay 20 B. W. G. ...Cwt.	5$\frac{3}{4}$	10	8	Cwt.	60	6					
Ridge Capping ... R.F.	10	0	9	R.F.	5	10					
Galvanized iron Guttering ... R.F.	20	0	14	R.F.	17	8					
Washers, rivets, screws, &c. ... S.F.	255	3	0	100	7	10					
Sundries			.....		2	0					
		Total Materials.			187	5					
Labour.											
On framed timber. C.F.	5·17	0	12	C.F.	3	14					
On wrought timber ... ... C.F.	14	0	6	C.F.	5	4					
On fitting iron-work ...	...		.....		1	6					
On laying planking S.F.	185	2	4	100	4	3					
Rivetting and fixing sheets ... ... S.F.	255	4	0	100	10	3					
Cutting sheets ...Cwt.	5$\frac{3}{4}$	0	3	Cwt.	1	1					
Fixing ridge ... R.F.	10	5	0	100	0	8					
Fixing gutters ... R.F.	20	3	6	100	0	11					
Carriage of iron sheets ... ...Cwt.	5$\frac{3}{4}$	2	8	Cwt.	14	6					
Carriage of timber. C.F.	28	0	4	C.F.	7	0					
Sundries			.....		0	8					
Add.		Total Labour ..			49	0					
Galvanized iron wire netting... ... S.F.	10	35	4	100	3	8					
Total for 255 S.F. Roofing completed...					239	13					
Or for 100 S.F. Roofing completed...					94	1					

Construction.—Trusses 10 feet apart, purlins 4″ × 5$\frac{3}{4}$″ at 3 feet apart, teak planking $\frac{1}{2}$″ screwed to underside of purlins, ridge pole 2$\frac{1}{2}$″×7″, wall plate 4″ × 3$\frac{1}{2}$″, covering of Galvanized Corrugated iron 20 B.W.G., wire netting $\frac{2}{3}$″ Mesh under ridge pole.

CXXIX.—Corrugated Iron Roofing, xviii feet Span (Kingpost).

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per.	Rs. a.
Timber in scantling in Bombay (Teak)..C.F.	20·3	3 0 C.F.	60 14			
Iron-work in trusses ... ... lbs.	23	0 3 lb.	4 5			
Nails for purlins &c. lbs.	11	0 2 lb.	1 6			
Teak planking $6'' \times \frac{1}{2}''$ ... ... S.F.	237	14 0 100	33 3			
Screws $1\frac{1}{4}''$ ... doz.	24	0 2 doz.	3 0			
Galvanized Corrugated iron in Bombay 20 B. W. G. ...Cwt.	$6\frac{1}{4}$	10 8 Cwt.	65 10			
Ridge Capping ...R.F.	10	0 9 R.F.	5 10			
Galvanized iron Guttering ...R.F.	20	0 14 R.F.	17 8			
Washers, rivets, screws, &c. ... S.F.	275	3 0 100	8 4			
Sundries	...	.....	2 0			
		Total Materials.	201 12			
Labour.						
On framed timber.C.F.	6·26	0 12 C.F.	4 11			
On wrought timberC.F.	14	0 6 C.F.	5 4			
On fitting iron-work ...	...	.....	1 7			
On laying planking S.F.	215	2 4 100	4 13			
Rivetting and fixing sheets... ... S.F.	275	4 0 100	11 0			
Cutting sheets ...Cwt.	$6\frac{1}{4}$	0 3 Cwt.	1 3			
Fixing Ridge ... R.F.	10	5 0 100	0 8			
Fixing Gutters ... R.F.	20	3 6 100	0 11			
Carriage of iron sheets ... ...Cwt.	$6\frac{1}{4}$	2 8 Cwt.	15 10			
Carriage of timber. C.F.	30	0 4 C.F.	7 8			
Sundries	...	.....	0 8			
Add.		Total Labour...	53 3			
Galvanized iron wire netting ... S.F.	10	35 4 100	3 8			
Total for 275 S. F. Roofing completed...			258 7			
Or for 100 S. F. Roofing completed...			94 0			

Construction.—Trusses 10 feet apart, purlins $4'' \times 5\frac{3}{4}''$ at 3 feet apart, teak planking $\frac{1}{2}''$ screwed to underside of purlins, ridge pole $2\frac{1}{2}'' \times 7''$, wall plate $4'' \times 3\frac{1}{2}''$, covering of Galvanized Corrugated Iron 20 B.W.G., wire netting $\frac{3}{4}''$ Mesh under ridge pole.

CXXX.—Corrugated Iron Roofing, xx feet Span (Kingpost).

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount.
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Timber in scantling in Bombay (Teak).. C.F.	21·7	3 0 C.F.	65 2			
Iron-work in trusses ... ... lbs.	24	0 3 lb.	4 8			
Nails for purlins, &c. lbs	12	0 2 lb.	1 8			
Teak planking 6″×½″ ... ... S.F.	259	14 0 100	36 4			
Screws 1¼″ dozen.	26	0 2 doz.	3 4			
Galvanized Corrugated iron in Bombay 20 B. W. G. ...Cwt.	7	10 8 Cwt.	73 8			
Ridge Capping ... R.F.	10	0 9 R.F.	5 10			
Galvanized iron Guttering ... R.F.	20	0 14 R.F.	17 8			
Washers, rivets, screws, &c. ... S.F.	300	3 0 100	9 0			
Sundries	...	.....	2 4			
		Total Materials.	218 8			
Labour.						
On framed timber. C.F.	7·63	0 12 C.F.	5 12			
On wrought timber ... ... C.F.	14	0 6 C.F.	5 4			
On fitting iron-work ...	...	.....	1 8			
On laying planking S.F.	235	2 4 100	5 5			
Rivetting and fixing sheets ... ... S.F.	300	4 0 100	12 0			
Cutting sheets ...Cwt.	7	0 3 Cwt.	1 5			
Fixing Ridge ...R.F.	10	5 0 100	0 8			
Fixing Gutters ... R.F.	20	3 6 100	0 11			
Carriage of iron sheets ... ...Cwt.	7	2 8 Cwt.	17 8			
Carriage of timber. C.F.	32	0 4 C.F.	8 0			
Sundries	...	.....	0 12			
Add.		Total Labour ...	58 9			
Galvanized iron wire netting ... S.F.	10	35 4 100	3 8			
Total for 300 S.F. Roofing completed ...			280 9			
Or for 300 S.F. Roofing completed ...			93 8			

Construction.—Trusses 10 feet apart, purlins 4″×5¾″ at 3 feet apart., teak planking ½″ screwed to underside of purlins, ridge pole 2½″×7″, wall plate 4″×3½″, covering of Galvanized Corrugated Iron 20 B.W.G., wire netting ⅜″ Mesh under ridge pole.

CXXXI.—Corrugated Iron Roofing, xxii feet Span (Kingpost).

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount.
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per.	Rs. a.
Timber in scantling in Bombay (Teak). C.F.	25·9	3 0 C.F.	77 11			
Iron-work in trusses ... ... lbs.	29	0 3 lb.	5 7			
Nails for purlins &c. lbs.	15	0 2 lb.	1 14			
Teak planking 6″×½″ ... ... S.F.	292	14 0 100	40 14			
Screws 1¼″ ... doz.	29	0 2 doz.	3 10			
Corrugated iron in Bombay 20 B.W.G. ...Cwt.	7½	10 8 Cwt.	78 12			
Ridge Capping ... R.F.	10	0 9 R.F.	5 10			
Galvanized iron Guttering ...R.F.	20	0 14 R.F.	17 8			
Washers, rivets, screws, &c. ...S.F.	325	3 0 100	9 12			
Sundries	...	.....	2 8			
		Total Materials.	243 10			
Labour.						
On framed timber. C.F.	8·68	0 12 C.F.	6 8			
On wrought timber ... ...C.F.	17·2	0 6 C.F.	6 8			
On fitting iron-work ...	...	.....	1 13			
On laying planking S.F.	265	2 4 100	5 15			
Rivetting and fixing sheets... ... S.F.	325	4 0 100	13 0			
Cutting sheets ...Cwt.	7½	0 3 Cwt.	1 6			
Fixing Ridge ... R.F.	10	5 0 100	0 8			
Fixing Gutters ...R.F.	20	3 6 100	0 11			
Carriage of iron sheets ... ...Cwt.	7½	2 8 Cwt.	18 12			
Carriage of timber. C.F.	38	0 4 C.F.	9 8			
Sundries	...	.....	0 12			
Add,		Total Labour...	65 5			
Galvanized iron wire netting ... S.F.	10	35 4 100	3 8			
Total for 325 S.F. Roofing completed ...			312 7			
Or for 100 S.F. Roofing completed ...			96 2			

Construction.—Trusses 10 feet apart, purlins 4″×5¾″ at 3 feet apart, teak planking ½″ screwed to underside of purlins, ridge pole 2½″×7″, wall plate 4″×3½″, covering of Galvanized Corrugated Iron 20 B.W.G., wire netting ¾″ Mesh under ridge pole.

CXXXII.—Terraced Roofing, viii feet Span.

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount.
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Teakwood in scantling ... ... C.F.	10¼	3 0 C.F.	30 12			
Flat tiles... ... No.	480	15 0 1,000	7 3			
Lime ... ... C.F.	5	12 0 40 C.F.	1 8			
Sand ... ... C.F.	7½	2 0 100	0 2			
Sundries	...	.....	0 8			
		Total Materials .	40 1			
Labour.						
On wrought timber C.F.	10¼	0 6 C.F.	3 13			
Masons for setting tiles ... ... No.	3	0 10 each.	1 14			
Coolies ... ... No.	3	0 3 do.	0 9			
Bhisties ... ... No.	½	0 8 do.	0 4			
Grinding chunam . C.F.	7½	3 0 100	0 4			
White wash ... S.F.	200	0 8 do.	1 0			
Sundries	...	.. ...	0 4			
		Total Labour ...	8 0			
Add.						
Concrete ... C.F.	20	20 0 100	4 0			
Total for 80 S.F. of Terraced Roofing ...			52 1			
Or per 100 S.F. of Terraced Roofing ...			65 1			

Note.—The cost of Terraced Roofing *exclusive of wood-work* would be Rs. 22 per 100 S.F.; its weight is assumed to be 75 lbs. per square foot, including wood-work.

Construction.—Joists 3″×4½″ at 1 foot apart, supporting 2 layers of flat tiles 12″×6″×1″, covered with 3″ of fine concrete, and finished off with a surface layer of tiles also 12″×6″×1″.

Note.—Scantlings of Joists for the following spans :—
VI feet Span 3″×3½″.
VIII do. do. 3″×4½″.

CXXXIII.—Terraced Roofing, xii feet Span.

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Teakwood in scantling ... ...C.F.	19½	3 0 C.F.	58 8			
Flat tiles ... ... No.	720	15 0 1,000	10 13			
Lime ... ...C.F.	8	12 0 40 C.F.	2 6			
Sand ... ...C.F.	12	2 0 100	0 4			
Sundries	...	.....	0 12			
Labour.		Total Materials.	72 11			
On wrought timber C.F	19½	0 6 C.F.	7 5			
Masons for setting tiles ... ... No.	5	0 10 each.	3 2			
Coolies ... ... No.	5	0 3 do.	0 15			
Bhisties ... ... No.	½	0 8 do.	0 4			
Grinding chunam .C.F.	12	3 0 100	0 6			
White wash ...S.F.	300	0 8 do.	1 8			
Sundries	...	.....	0 6			
		Total Labour ...	13 14			
Add.						
Concrete	30	20 0 100	6 0			
Total for 120 S.F. of Terraced Roofing...			92 9			
Or per 100 S.F. of Terraced Roofing...			77 2			

Note.—The cost of Terraced Roofing *exclusive of wood-work* would be Rs. 22 per 100 S.F; its weight is assumed to be 75 lbs. per square foot, including wood-work.

Construction.—Joists 3″×6½″ at 1 foot apart, supporting 2 layers of flat tiles 12″×6″×1″, covered with 3″ of fine concrete and finished off with a surface layer of tiles also 12″×6″×1″.

Note.—Scantlings of Joists for the following spans :—

X feet Span 3″×5¼″.
XII do. do. 3″×6½″.
XIV do. do. 3″×7¼″.

CXXXIV.—Terraced Roofing, xvi feet Span.

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Teakwood in scantling ... ...C.F.	32	3 0 C.F.	96 0			
Flat tiles ... No.	960	15 0 1,000	14 6			
Lime ... ...C.F.	10	12 0 40C.F.	3 0			
Sand ... ...C.F.	15	2 0 100	0 5			
Sundries	...	.....	1 0			
Labour.		Total Materials.	114 11			
On wrought timberC.F.	32	0 6 C.F.	12 0			
Masons for setting tiles ... ... No.	6	0 10 each.	3 12			
Coolies ... ... No.	6	0 3 do.	1 2			
Bhisties ... ... No.	½	0 8 do.	0 4			
Grinding chunam. C.F.	15	3 0 100	0 7			
White wash ... S.F.	400	0 8 do.	2 0			
Sundries	...	.....	0 8			
		Total Labour...	20 1			
Add.						
Concrete ... ...C.F.	40	20 0 100	8 0			
Total for 160 S.F. of Terraced Roofing ...			142 12			
Or per 100 S.F. of Terraced Roofing ...			89 3			

Note.—The cost of Terraced Roofing *exclusive of wood-work* would be Rs. 22 per 100 S.F.; its weight is assumed to be 75 lbs. per square foot including wood-work.

Construction.—Joists 3″×8¼″ at 1 foot apart, supporting 2 layers of flat tiles 12″×6″×1″, covered with 3″ of fine concrete and finished off with a surface layer of tiles also 12″×6″×1″.

Note.—Scantlings of Joists for the following spans :—

XVI feet Span. 3″×8¼″.
XVIII do. do. 3″×9½″.
XX do. do. 3″×10¼″.

CXXXVI.—Belgaum Tiled Roof Covering.

Artificers, Labourers, and Materials for 100 Superficial Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Battens, teak ... C.F.	24	1 8 100	3 10			
Nails for battens and rafters	6	1 0 6 lbs.	1 0			
Flat tiles, "Sudda beelas," 5″×5″×½″ ...	650	4 0 1,000	2 10			
Round tiles 15½′×5½′ No.	440	11 0 1,000	4 13			
Lime, slaked ... C.F.	3	12 0 40 C.F.	0 14			
Sand ... ... C.F.	4½	2 0 100 C.F.	0 2			
Sundries	...	.....	0 4			
		Total Materials.	13 5			
Labour.						
Masons	3	0 8 each.	1 8			
Carpenter	1	0 12 do.	0 12			
Coolies...	2	0 3 do.	0 6			
Women	6	0 2 do.	0 12			
Bhisti	¼	0 8 do.	0 2			
Grinding chunam. C.F.	5	3 0 100 C.F.	0 3			
Sundries	...	.....	0 4			
		Total Labour ...	3 15			
Total for 100 S.F. of Roof Covering ...			17 4		Total for 100 S.F. of Roof Covering ...	

CXXXVII.—Taylor's Tiles.

	£	s.	d.
Cost in England of dull red colour per 1,000	6	15	0
Hip, each working 12″ run	0	1	2
Pair of ridge, each working 15″ run...	0	1	5
Galvanized tile nails, one to each tile for 1,000	0	5	0
	Rs.	a.	p.
Freight from England to Bombay per 1,000 at 44 square yards to the ton, about	35	0	0
Extra tiles to be ordered out for breakage at 20 per cent.			
Cost of laying on roofs in Bombay	2	5	0

Artificers, Labourers, and Materials for 100 Cubic Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount.
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Battens teak 3″×¾″, S.F. 120 or ... C.F.	1·87	3 0 C.F.	5 10			
Nails for battens and rafters ... ... lbs.	5	1 0 6 lbs.	0 13			
Tiles, 12¾″ × 8½″, including 20 per cent. for breakage	222	110 0 1,000	24 7			
Nails, galvanized ...	222	4 0 1,000	0 14			
Sundries	...	.....	0 8			
		Total Materials.	32 4			
Labour.						
Carpenter	1	0 12 each.	0 12			
Cooly	1	0 3 do.	0 3			
Laying tiles ... S.F.	100	2 5 100	2 5			
Sundries	...	.....	0 8			
		Total Labour ...	3 12			
Totol for 100 S.F. Roof Covering ...			36 0		Total for 100 S·F. Roof Covering.	

CXXXVII (*a*).—Taylor's Ridge or Hip.

Artificers, Labourers and Materials for 100 Running Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Ridge tiles Pairs	80	1 0 Pair	80 0			
Do. for breakage 20 per cent	16	1 0 do.	16 0			
		Total Materials.	96 0			
Labour.						
Fixing ... ...R.F.	100	8 6 100	8 6			
Sundries	...	.....	0 10			
		Total Labour ...	9 0			
Total for 100 Running Feet ...			105 0	Total for 100 R.F. ...		

Note.—Colonel Fuller's rate for tiles laid on roof (exclusive of all wood-work, rafters and battens or planking) including nails, hips, ridges, breakage, &c., is Rs. 32 per 100 S.F.

	Lbs.
Weight of Taylor's tiles, dry, per 100 S.F.	674
Do. do. wet, do.	796
Do. of ordinary native tiles, single, dry, per 100 S.F.	... 1,312
Do. do. do. wet, do. ...	... 1,462
Do. do. do. double dry, do. ...	... 2,624
Do. do. do. wet, do. ...	... 2,924
Do. Mangalore tiles, dry, do. ...	... 722
Do. do. wet, do. ...	... 844

CXXXVIII.—Mangalore Tiles.

Artificers, Labourers and Materials for 100 Supl. Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Ra. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Battens 1″ × 1¾″, 100 R. ft., or ... C.F.	1·25	3 0 C. F.	3 12			
Nails for rafters and battens ... lbs.	5	1 0 6 lbs.	0 13			
Tiles, 16″ × 9¼″, including 10 per cent. for breakage, in Mangalore	165	50 0 1,000	8 4			
Sundries	...	... ...	0 5			
		Total Materials.	13 2			
Labour.						
Freight to Bombay No.	165	30 0 1,000	4 15			
Carpenter	1	0 12 each.	0 12			
Tile-layer	1	0 8 do.	0 8			
Coolies	2	0 3 do.	0 6			
Women	2	0 2 do.	0 4			
Sundries		... ...	0 4			
		Total Labour...	7 1			
Total for 100 Supl. Ft. Roof Covering...			20 3	Total for 100 Supl. Ft. Roof Covering...		

CXXXVIII (*a*).—Mangalore Ridge Tiles.

Artificers, Labourers and Materials for 100 Running Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Ridge tiles at Mangalore ... No.	110	50 0 1,000	5 8			
Lime ... C. F.	6	12 0 40 C. F.	1 13			
Sand ... C. F.	9	2 0 100 C. F.	0 3			
Sundries	...	... ...	0 4			
		Total Materials.	7 12			
Labour.						
Freight to Bombay ...	110	30 0 1,000	3 5			
Bricklayers... ...	3	0 10 each.	1 14			
Coolies	2	0 3 do.	0 6			
Women	2	0 2 do.	0 4			
Grinding chunam C. F.	9	3 0 100 C. F.	0 4			
Sundries	...	... ...	0 4			
		Total Labour ...	6 5			
		Total for 100 R.F...	14 1		Total for 100 R.F...	

CXLVI.—Gutters and Valleys of Sheet Lead.

Artificers, Labourers and Materials for 100 Running Feet.	No. or quantity.	Rate.	Amount.	No. or quantity.	Rate.	Amount.
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Teakwood ... C.F.	23	3 0 C. F.	69 0			
Sheet lead 6 lbs. to the square foot Cwt.	16	17 8 Cwt.	280 0			
Sundries, such as nails, &c.	...	... ...	1 0			
		Total Materials	350 0			
Labour.						
Carpenters	10	0 12 each.	7 8			
Coolies	10	0 3 do.	1 14			
Sundries	...	... ...	0 10			
		Total Labour...	10 0			
Add.						
Dammering to woodwork	...	... ...	5 0			
Total for 100 Running Feet...			365 0	Total for 100 Running Feet... ...		
Or per Running Foot..			3 10	Or per Running Foot		

CXLVII.—Valleys of Sheet Iron.

Artificers, Labourers and Materials for 100 Running Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Teakwood ... C. F.	23	3 0 C.F.	69 0			
Sheet iron 110′ × 3′ × $\frac{1}{16}$″ Cwt.	7½	14 0 Cwt.	105 0			
Charcoal ... lbs.	240	1 0 80 lbs.	3 0			
Sundries	...	.....	1 0			
		Total Materials,	178 0			
Labour.						
Carpenters	6	0 12 each.	4 8			
Coolies	6	0 3 do.	1 2			
Smiths	6	0 12 do.	4 8			
Bellows-boys ...	6	0 4 do.	1 8			
Sundries	...	.....	0 6			
		Total Labour...	12 0			
Add.						
Dammering to wood and iron	...	.....	10 0			
Total for 100 Running Feet...			200 0	Total for 100 Running Feet		
Or per Running Foot...			2 0	Or per Running Foot		

VIII.—ROAD-WORK SPECIFICATIONS.

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CLI to CLXV—

See General Specifications Nos. XVII and XVIII for earth-work and metalling respectively.

NOTES.

Note (1).—Detailed Rates Nos. CLI to CLV are based on the Tables of task work circulated with G. R. No. 64, dated 14th January 1882, but modified slightly so as to give the cost of embankments and cuttings in ordinary road works. The tasks have been reduced about 14 per cent.

(2).—Detailed Rates Nos. CLVI and CLVII are for *general excavation* in soft and hard rock, and would not apply, for instance, in the case of the excavation of a well of small diameter, or any considerable depth.

(3). The cost of conveyance to road side in the case of long leads adds very materially to the cost of either moorum or metal at quarry site. This may, however, be ascertained for any lead up to 10 miles by the assistance of the Tables for calculating cost of conveying materials by carts or coolies. (See Section X further on.)

CLI.—Excavation in Black or Red Soil.

Lead in Feet.		Lift in Feet.	Cost per 100 Cubic Feet.								
From	To		Labour.			Establishment.			Sundries.			Total.		
			Rs.	a.	p.	Rs.	a.	p.	Rs.	a.	p.	Rs.	a.	p.
0	50	0 to 5	0	4	7	0	0	5	0	1	0	0	6	0
50	100		0	5	0	0	0	5	0	1	0	0	6	5
100	200		0	5	5	0	0	6	0	1	0	0	6	11
200	300		0	6	0	0	0	6	0	1	0	0	7	6
300	400		0	6	8	0	0	7	0	1	0	0	8	3
400	500		0	7	4	0	0	8	0	1	0	0	9	0
500	600		0	8	4	0	0	9	0	1	0	0	10	1
0	100	5 to 10	0	6	3	0	0	6	0	1	0	0	7	9
100	200		0	6	10	0	0	7	0	1	0	0	8	5
200	300		0	7	4	0	0	8	0	1	0	0	9	0
300	400		0	7	11	0	0	8	0	1	0	0	9	7
400	500		0	8	10	0	0	9	0	1	0	0	10	7
500	600		0	10	0	0	0	10	0	1	0	0	11	10
0	100	10 to 15	0	7	4	0	0	8	0	1	6	0	9	6
100	200		0	7	11	0	0	8	0	1	6	0	10	1
200	300		0	8	7	0	0	9	0	1	6	0	10	10
300	400		0	9	1	0	0	9	0	1	6	0	11	4
400	500		0	10	4	0	0	11	0	1	6	0	12	9
500	600		0	11	6	0	1	0	0	1	6	0	14	0
0	100	15 to 20	0	8	4	0	0	9	0	1	6	0	10	7
100	200		0	9	1	0	0	9	0	1	6	0	11	4
200	300		0	9	8	0	0	10	0	1	6	0	12	0
300	400		0	10	9	0	0	11	0	1	6	0	13	2
400	500		0	11	6	0	1	0	0	1	6	0	14	0
500	600		0	13	1	0	1	1	0	1	6	0	15	8

N.B.—The above Table is calculated on the assumption that the ordinary daily pay of a cooly is 3 annas.

CLII.—Excavation in Soft Moorum.

Lead in Feet.		Lift in Feet.	Cost per 100 Cubic Feet.								
From	To		Labour.			Establishment.			Sundries.			Total.		
			Rs.	a.	p.	Rs.	a.	p.	Rs.	a.	p.	Rs.	a.	p.
0	50	0 to 5	0	5	8	0	0	6	0	1	0	0	7	2
50	100		0	6	1	0	0	6	0	1	0	0	7	7
100	200		0	6	8	0	0	7	0	1	0	0	8	3
200	300		0	7	4	0	0	8	0	1	0	0	9	0
300	400		0	8	4	0	0	8	0	1	0	0	10	0
400	500		0	8	10	0	0	9	0	1	0	0	10	7
500	600		0	10	0	0	0	11	0	1	0	0	11	11
0	100	5 to 10	0	7	8	0	0	8	0	1	0	0	9	4
100	200		0	8	4	0	0	9	0	1	0	0	10	1
200	300		0	8	10	0	0	9	0	1	0	0	10	7
300	400		0	9	8	0	0	10	0	1	0	0	11	6
400	500		0	10	9	0	0	11	0	1	0	0	12	8
500	600		0	12	0	0	1	1	0	1	0	0	14	1
0	100	10 to 15	0	8	10	0	0	9	0	1	6	0	11	1
100	200		0	9	8	0	0	10	0	1	6	0	12	0
200	300		0	10	4	0	0	11	0	1	6	0	12	9
300	400		0	11	1	0	1	0	0	1	6	0	13	7
400	500		0	12	6	0	1	1	0	1	6	0	15	1
500	600		0	14	3	0	1	3	0	1	6	1	1	0
0	100	15 to 20	0	10	0	0	0	11	0	1	6	0	12	5
100	200		0	11	1	0	1	0	0	1	6	0	13	7
200	300		0	12	0	0	1	0	0	1	6	0	14	6
300	400		0	13	1	0	1	2	0	1	6	0	15	9
400	500		0	14	3	0	1	3	0	1	6	1	1	0
500	600		0	15	10	0	1	5	0	1	6	1	2	9

N.B.—The above Table is calculated on the assumption that the ordinary daily pay of a cooly is 3 annas,

CLIII.—Excavation in Average Moorum.

Lead in Feet.		Lift in Feet.	Cost per 100 Cubic Feet.			
From	To		Labour.	Establishment.	Sundries.	Total.
			Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.
0	50	0 to 5	0 7 2	0 0 8	0 1 3	0 9 0
50	100		0 7 11	0 0 7	0 1 3	0 9 10
100	200		0 8 7	0 0 9	0 1 3	0 10 7
200	300		0 9 5	0 0 10	0 1 3	0 11 6
300	400		0 10 4	0 0 11	0 1 3	0 12 6
400	500		0 11 6	0 1 0	0 1 3	0 13 9
500	600		0 13 1	0 1 1	0 1 3	0 15 5
0	100	5 to 10	0 9 8	0 0 10	0 1 3	0 11 9
100	200		0 10 9	0 0 11	0 1 3	0 12 7
200	300		0 11 6	0 1 0	0 1 3	0 13 9
300	400		0 12 6	0 1 1	0 1 3	0 14 10
400	500		0 13 8	0 1 2	0 1 3	1 0 1
500	600		0 15 10	0 1 4	0 1 3	1 2 5
0	100	10 to 15	0 11 6	0 1 0	0 1 9	0 14 3
100	200		0 12 6	0 1 1	0 1 9	0 15 4
200	300		0 13 8	0 1 2	0 1 9	1 0 7
300	400		0 14 3	0 1 3	0 1 9	1 1 3
400	500		0 15 10	0 1 5	0 1 9	1 3 0
500	600		1 1 8	0 1 7	0 1 9	1 5 0
0	100	15 to 20	0 13 1	0 1 2	0 1 9	1 0 0
100	200		0 14 3	0 1 3	0 1 9	1 1 3
200	300		0 15 0	0 1 4	0 1 9	1 2 1
300	400		1 0 8	0 1 5	0 1 9	1 3 10
400	500		1 1 8	0 1 7	0 1 9	1 5 0
500	600		1 4 0	0 1 9	0 1 9	1 7 6

N.B.—The above Table is calculated on the assumption that the ordinary daily pay of a cooly is 3 annas.

CLIV.—Excavation in Hard Moorum.

Lead in Feet.		Lift in Feet.	Cost per 100 Cubic Feet.								
From.	To.		Labour.			Establishment.			Sundries.			Total.		
			Rs.	a.	p.	Rs.	a.	p.	Rs.	a.	p.	Rs.	a.	p.
0	50	0 to 5	0	10	0	0	0	10	0	1	6	0	12	4
50	100		0	10	9	0	0	11	0	1	6	0	13	2
100	200		0	12	0	0	1	0	0	1	6	0	14	6
200	300		0	13	1	0	1	2	0	1	6	0	15	9
300	400		0	14	3	0	1	3	0	1	6	1	1	0
400	500		0	15	10	0	1	5	0	1	6	1	2	9
500	600		1	1	8	0	1	7	0	1	6	1	4	9
0	100	5 to 10	0	13	8	0	1	2	0	1	6	1	0	4
100	200		0	15	0	0	1	3	0	1	6	1	1	9
200	300		0	15	10	0	1	5	0	1	6	1	2	9
300	400		1	1	8	0	1	6	0	1	6	1	4	8
400	500		1	2	9	0	1	8	0	1	6	1	5	11
500	600		1	5	5	0	1	11	0	1	6	1	8	10
0	100	10 to 15	0	15	10	0	1	5	0	2	0	1	3	3
100	200		1	1	8	0	1	6	0	2	0	1	5	2
200	300		1	2	9	0	1	7	0	2	0	1	6	4
300	400		1	4	0	0	1	8	0	2	0	1	7	8
400	500		1	7	1	0	1	11	0	2	0	1	11	0
500	600		1	9	0	0	2	2	0	2	0	1	13	2
0	100	15 to 20	1	1	8	0	1	7	0	2	0	1	5	3
100	200		1	4	0	0	1	8	0	2	0	1	7	8
200	300		1	5	5	0	1	10	0	2	0	1	9	3
300	400		1	7	1	0	2	0	0	2	0	1	11	1
400	500		1	9	0	0	2	2	0	2	0	1	13	2
500	600		1	11	3	0	2	6	0	2	0	1	15	9

N.B.—The above Table is calculated on the assumption that the ordinary daily pay of a cooly is 3 annas.

CLV.—Excavation in Loose Earth or Sand.

Lead in Feet.		Lift in Feet.	Cost per 100 Cubic Feet.								
From.	To.		Labour.			Establishment.			Sundries.			Total.		
			Rs.	a.	p.	Rs.	a.	p.	Rs.	a.	p.	Rs.	a.	p.
0	50	0 to 5	0	3	8	0	0	4	0	1	0	0	5	0
50	100		0	4	0	0	0	4	0	1	0	0	5	4
100	200		0	4	4	0	0	5	0	1	0	0	5	9
200	300		0	4	9	0	0	5	0	1	0	0	6	2
300	400		0	5	4	0	0	6	0	1	0	0	6	10
400	500		0	5	11	0	0	6	0	1	0	0	7	5
500	600		0	6	8	0	0	7	0	1	0	0	8	3
0	100	5 to 10	0	5	0	0	0	5	0	1	0	0	5	5
100	200		0	5	5	0	0	6	0	1	0	0	6	11
200	300		0	5	11	0	0	6	0	1	0	0	7	5
300	400		0	6	3	0	0	7	0	1	0	0	7	10
400	500		0	7	0	0	0	7	0	1	0	0	8	7
500	600		0	7	11	0	0	8	0	1	0	0	9	7
0	100	10 to 15	0	5	11	0	0	6	0	1	6	0	7	11
100	200		0	6	3	0	0	7	0	1	6	0	8	4
200	300		0	6	10	0	0	7	0	1	6	0	8	11
300	400		0	7	4	0	0	8	0	1	6	0	9	6
400	500		0	8	4	0	0	9	0	1	6	0	10	7
500	600		0	9	1	0	0	10	0	1	6	0	11	5
0	100	15 to 20	0	6	8	0	0	7	0	1	6	0	8	9
100	200		0	7	4	0	0	8	0	1	6	0	9	6
200	300		0	7	8	0	0	8	0	1	6	0	9	10
300	400		0	8	7	0	0	9	0	1	6	0	10	10
400	500		0	9	1	0	0	10	0	1	6	0	11	5
500	600		0	10	4	0	0	11	0	1	6	0	12	9

N.B.—The above Table is calculated on the assumption that the ordinary daily pay of a cooly is 3 annas.

CLVI.—Excavation in Soft Rock.

Labour and Materials per 100 Cubic Feet.	No. or quantity.	Rate.			Amount		No. or quantity.	Rate.			Amount	
		Rs.	a.	Per	Rs.	a.		Rs.	a.	Per	Rs.	a.
Miners...	2	0	4	each.	0	8						
Coolies	4	0	3	do.	0	12						
Women	2	0	2	do.	0	4						
Smith and Bellows-boy	¼	1	0	do.	0	4						
Sundries			.....		0	4						
Total for 100 C.F. ...					2	0	Total for 100 C.F.					

CLVII.—Excavation in Hard Rock.

Labour and Materials for 100 Cubic Feet.	No. or quantity.	Rate.			Amount		No. or quantity.	Rate.			Amount	
		Rs.	a.	Per	Rs.	a.		Rs.	a.	Per	Rs.	a.
Miners...	6	0	4	each.	1	8						
Coolies...	4	0	3	do.	0	12						
Women	2	0	2	do.	0	4						
Smith	½	0	12	do.	0	6						
Bellows-boy	½	0	4	do.	0	2						
Hammer-man... ...	½	0	6	do.	0	3						
Blasting powder. lbs.	10	1	0	5 lbs.	2	0						
Charcoal ... lbs.	15	1	0	80 lbs.	0	3						
Steel and Sundries ...	...		.....		0	6						
Total for 100 C.F. ...					5	12	Total for 100 C.F.					

CLVIII.—Moorum for Road Surface.

Labour and Materials for 100 Cubic Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Digging and stacking at the Quarry for hard moorum ...	...	.....	1 0			
*Conveying and stacking at the roadside up to ½ a mile ...	...	.....	...			
Cart ... ...No.	1	0 12 each.	0 12			
Coolies ...	¼	0 3 do.	0 ¾			
Women ...	¼	0 2 do.	0 ½			
Sundries ...	...	.....	0 ¾			
For every additional ½ mile add 1 cart ...	...	.....	...			
Total for 100 C.F. stacking at roadside.	...	.....	0 14		Total for 100 C.F. stacking at roadside	
Spreading Moorum.						
Coolies...	½	0 3 each.	0 1½			
Women	1	0 2 do.	0 2			
Sundries	...	.....	0 ½			
Total for 100 C.F. spreading moorum ...			0 4		Total for 100 C.F. spreading moorum.	

* *Note.*—For cost of conveyance by carts or coolies for any lead up to 10 miles see Tables of cart and coolie-hire in Section X further on.

CLIX.—Watering and Rolling Moorum for Road Surface.

Labour and Materials for 1 mile of road, coating 3″ thick and 20′ wide,	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Watering.						
Water carts	28	0 12 do.	21 0			
Coolies	28	0 3 do.	5 4			
Sundries	...	.....	1 4			
		Total Watering.	27 8			
Rolling.						
Bullocks ... pairs.	28	0 12 each.	21 0			
Coolies ... No.	14	0 3 do.	2 10			
Sundries	...	.....	3 6			
		Total Rolling...	27 0			
Total for watering and rolling per mile.			54 8		Total for watering & rolling per mile...	

Note.—A 3 feet or 2 ton roller drawn by 4 pairs of bullocks will travel about 10 miles a day over new moorum surface; the above allows for a roller, 3′ long, passing 10 times over the whole; therefore 7 days are required for consolidation. 4 carts would be required to keep the surface properly watered if the water is not brought from a distance exceeding ½ a mile. For a 6″ or 8″ coat of moorum take 1½ times the above.

CLX.—Stone Metal from Boulders.

Labour and Materials for 100 Cubic Feet of 1½" Metal.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Coolies for quarrying. No.	2	0 4 each.	0 8			
Hammer-man	1	0 6 do.	0 6			
Women for breaking ...	12	0 2 do.	1 8			
Sundries...	...	.....	0 2			
Total for breaking per 100 Cubic Feet...			2 8	Total for breaking per 100 C. F....		

CLXI.—From Blasted Rubble.

Labour and Materials for 100 Cubic Feet of 1½" Metal.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Labour.						
Hammer-man ...No	1	0 6 each.	0 6			
Women for breaking ...	10	0 2 do.	1 4			
Smith do. ...	...	.....	0 2			
		Total Labour...	1 12			
Materials.						
Rubble Stone ...C. F.	100	3 0 100 C.F.	3 0			
Sundries	...	.....	0 2			
		Total Materials.	3 2			
Total for breaking per 100 Cubic Feet...			4 14	Total for breaking per 100 C. F....		

CLXII.—Carrying and Stacking Metal.

Labour and Materials for 100 Cubic Feet of 1½" Metal.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
**Carrying to a distance of ½ mile and stacking by roadside.*						
Cart ... ... No.	1	0 12 each.	0 12			
Coolies...	½	0 3 do.	0 1½			
Women	½	0 2 do.	0 1			
Sundries	...	.....	0 1½			
		Total for 100 C.F. ...	1 0		Total for 100 C.F.	

For every additional ½ mile road add 1 cart.

Note.—An ordinary country cart can carry a load of about 8 cwts. a distance of 7 miles and return empty the same day.

* *Note.*—For cost of conveyance by carts or coolies for any lead up to 10 miles, see Tables of cart and coolie hire in Section X further on.

Note.—From some experiments made by the compositor it would appear that trap weighing 180 lbs. per cubic foot when broken into metal weighs about 96 lbs. per cubic foot. As a general rule, metal weighs 50 per cent. less than the weight of the stone itself. Laterite metal broken to pass through a 2½ inch ring weighs about 77 lbs. per cubic foot.

CLXIII.—Picking up surface and Spreading.

Labour and Materials for 100 Cubic Feet of 1½" Metal.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Spreading.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Coolies ... ... No.	1	0 3 each.	0 3			
Women	2	0 2 do.	0 4			
Sundries	...	.....	0 1			
		Total per 100 C.F.	0 8		Total per 100 C.F.	
Picking up surface.						
Coolies per 100 Supl. ft..	½	0 3 do.	0 1½			
Total for 100 Supl. Feet...			0 3½	Total for 100 Supl. Feet.		

CLXIV.—Consolidating.

By rolling with bullocks.

Labour and Materials for 1 mile of road 18' wide 3" watering.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Bullocks, pairs	105	0 12 each	78 12			
Watering carts	42	0 12 do.	31 8			
Coolies	63	0 3 do.	11 13			
Sundries	...	.....	2 8			
Total consolidating...			124 9	Total consolidating.		

Note.—This rate is framed on the assumption that a 2-ton roller will travel about 7 miles per day on new metal surface when drawn by 5 pairs of bullocks, and that at least 25 turns in each part of the surface should be given.

CLXV.—Steam Rolling with 15 Ton Roller.

For one mile.

Labour and Materials for 1 mile of road 18′ wide 3″ thick.	No. or quantity.	Rate.			Amount	No. or quantity.	Rate.			Amount
		Rs.	a.	Per	Rs. a.		Rs.	a.	Per	Rs. a.
Steam roller working days.	3¼	20	0	each	65* 0					
Repairs and depreciation days.	3¼	5	0	do.	16 4					
					81 4					

*The rate is given by the Executive Engineer, Poona and Kirkee, and the details of the charge 20/ per day are as follows :—

Establishment.

1 Native Driver at... ... Rs. 20 per mensem.
1 Steersman ... ... „ 15 „
1 Muccadum ... ... „ 15 „

	Rs.	a.	p.	Rs.	a.	p.
Total Establishment charge per diem, including conveyance of fuel, water, &c, ...				5	1	6
Wood 10 maunds=800 lbs. at 8/2 per candy ...	4	1	0			
Coal 6·38 „ 510 lbs. 1-9-9 per maund ...	10	4	3			
Petty stores	0	8	4			
				14	13	7
				19	15	1

Say Rs. 20.

The roller is worked by a 6 H.-P. engine, and is passed 15 times over each portion of the metal. This gives the daily distance travelled at about 14 miles.

Contract Rates for Road Repairs in Poona Cantonment in 1874-75.

Metal...	Rs.	3	2	0 per 100 C. F.
Spreading	„	0	5	6 „
Sand	„	1	10	0 „
Spreading	„	0	3	4 „
Picking up road surface ...	„	0	1	2 100 sq. feet.

IX.—MISCELLANEOUS.

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IX.—MISCELLANEOUS.

CLXVI to CLXXIII.—String Courses and Copings.

1. All cut stone in string courses, copings, &c., to be worked to such sizes, sections, or shapes as shown in working drawings, or as required by the design. The stones to be fine-dressed on face and joints, and rough tooled on beds, full, true, and out of winding. The joints to be true and close, and not to exceed $\frac{1}{8}''$. All visible edges and angles to be quite free from unsightly chippings.

Dressing and joints.

2. No stone to be less in any dimension than its height.

Size of stones.

3. All projecting stones, such as corbels, &c., to tail and bed back into the work at least twice the length of its entire projection, and at least $1\frac{1}{2}$ times its own height.

Corbels.

Note.—In string courses and copings, 2nd sort, the faces need only be rough tooled, and joints not to exceed $\frac{1}{4}$ inch in thickness.

CLXXIV.—Stone Steps.

1. To be of such shapes or sizes as may be shown on the drawings, and dressed on surface and joints as for paving 1st, 2nd, or 3rd sorts. (See Specification Nos. LV, LVI and LVII.)

Dressing.

2. The stones to lap uniformly for at least $1\frac{1}{2}''$, and when laid between walls to tail into the walls at least $1\frac{1}{2}''$. Every stone to be of the full breadth of the tread and lap and height of riser.

Size and over lap.

CLXXV.—Stone Stairs.

1. The stone to be fine chisel-dressed on all exposed faces, and of such shapes and sizes as may be shown in the drawings.

Dressing.

2. The steps to be of single stones, and to have mouldings and nosings returned at the ends (unless otherwise specified). The soffits to be dressed fair and sloped off.

Nosings.

3. The bottom step to be finished with a proper curtail.

Curtail.

4. When the steps rest on side walls or girders, they are to be solidly bedded, and to run into the wall at least 3 inches. When the stairs are geometrical, the stones are to run into the wall half its thickness, or at least 9 inches.

Side wall.

5. They are to be back-jointed as shown in drawing, and to bear on each other at least $\frac{1}{2}''$ per foot in length of step.

Lap.

6. The stones are to be laid on proper centres, which shall not be removed without permission nor till the baluster holes are cut.

Centres.

CLXXVI.—Wooden Staircase.

1. To be of best Moulmein teak, with risers 1¼″ thick, tongued and grooved top and bottom into treads 1¾″ thick, with moulded nosings along the fronts and returns.

Risers and Treads.

2. The soffits to be boarded with ¾″ teak planks framed with V joints, or tongued and grooved.

Soffits.

3. The steps to be properly framed into the inner and outer strings which are to be 14″ × 3″.

Strings.

4. Landings to have nosing and soffit corresponding to steps.

Landing.

5. The bottom steps to be finished with a proper curtail.

Curtail.

6. The steps to be supplied with teak hand rail and balusters of the pattern shown in drawings, properly fixed into treads.

Balusters and hand rail.

Note.—The following rule is often adopted for steps of the dimensions ordinarily required in practice, *i.e.*, those with treads from 9 to 14 inches wide.

Width of tread × height of riser = 66 inches, or for *any* width of tread the following :—

The width of tread added to twice the height of the rise should be equal to 23 inches.

CLXXVII.—Painting.

1. All wood and iron work exposed to the weather will receive 4 coats of paint: if in the interior of a building 3 coats will suffice. Paint should not be applied to wood-work unless it is well seasoned.

Number of coats.

2. Surfaces to be painted or varnished, to be thoroughly dry, clean, and smoothed, free from rust and dirt.

Cleaning.

3. After priming coat in which no colouring matter need be put, all holes, cracks, &c., to be stopped with putty and all knots to be properly killed.

Priming coat.

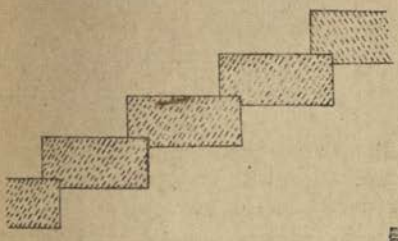
4. The paint to be thoroughly ground up in oil and mixed with the proper proportion of double boiled linseed oil and spirits of turpentine. Mineral turpentine on no account to be used.

Mixing.

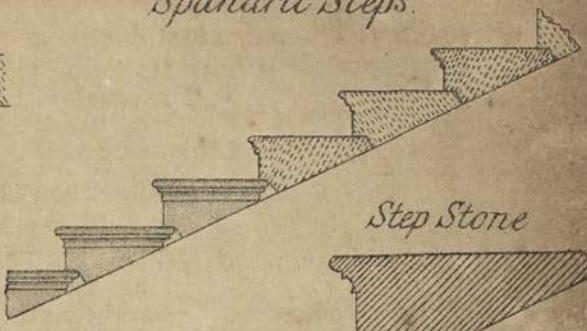
Note.—For proper proportion of linseed oil and turpentine in the different coats, see Notes on Paints, Washes, and Varnishes in Section XI further on.

STEPS AND STAIRS.

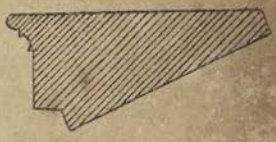
Square Steps.



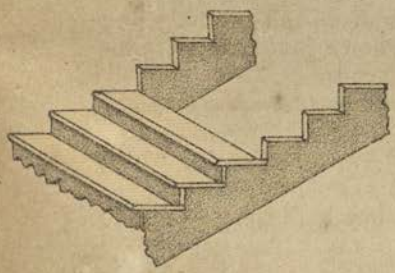
Spandril Steps.



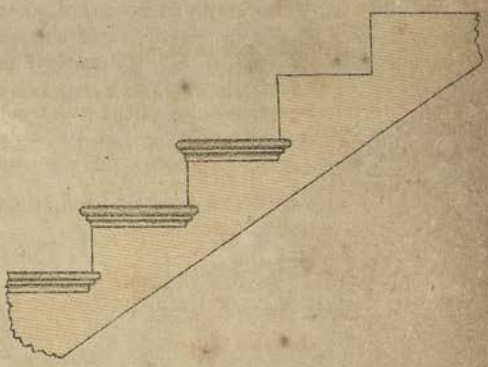
Step Stone



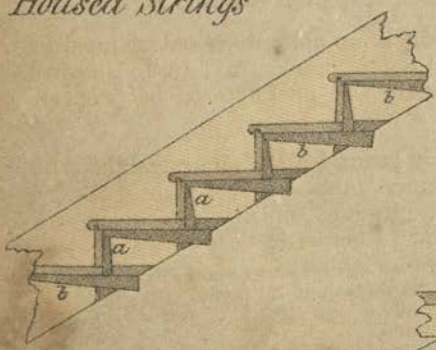
Cut Strings



Cut and Mitred Strings.

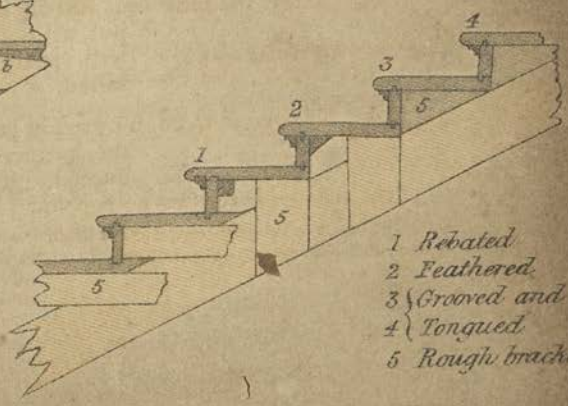


Housed Strings



a, b } Wedges

Wooden Steps.



1 Rebated
2 Feathered
3 } Grooved and
4 } Tongued
5 Rough brackets

Govt Photozinco Office, Poona. 1882.

5. For fine work each coat should be carefully rubbed down with pumice stone, or glass paper, and dusted before the next coat is added.

Fine work.

CLXXVIII.—Varnishing.

1. The wood-work when cleaned and rubbed down, to receive two coats of clean boiled linseed oil, or two coats of size laid on at sufficient intervals of time. When dry the varnish is to be smoothly laid on in thin coats.

Preparing surface.

2. The varnish used to be the best English copal, unless otherwise specified.

Copal varnish.

CLXXIX to CLXXXIII.—White-washing and Colour-washing.

1. To be prepared from fresh burnt white stone lime. The lime to be dissolved in a tub with a sufficient quantity of water, and the whole well mixed; when thoroughly mixed to be strained through a clean cloth; clean gum dissolved in hot water to be then added in the proportion of 2 oz. of gum arabic to 1 cubic foot of lime, or rice size may be used in place of gum.

White-washing.

2. Each coat to be laid on with a brush: one coat with a stroke of the brush from the top downwards, another from the bottom upwards over the first stroke, and similarly one stroke from the right and another from the left over the first brush before it dries. Three coats to be applied.

3. Before whitewash is laid on the surface of new walls, the walls to be well cleaned and brushed.

4. On walls which have been once whitewashed, the old loose whitewash to be first removed and the plaster repaired.

Note.—For the proportion of ingredients for different descriptions of colour-washing, see Notes on Paints, Washes, Varnishes, &c., in Section XI further on, and in Rates for the same from page 212 to 218.

CLXXXIV.—Papering.

1. The paper to be of an approved pattern.

Pattern.

2. The walls to be properly scraped and rubbed down quite free from any colour-wash or dirt. The walls should then be sized with parchment size or rice congee.

Cleaning and sizing.

3. If expensive paper is used, the walls to be first covered with a coating of lining paper. Wall to be quite dry before the paper is applied.

Lining paper.

4. The paper to be applied with paste made of best wheat flour and water, a little size or glue, blue stone (sulphate of copper) being added to prevent the attacks of insects. A little alum may also be added to make the paste spread and flow more easily.

Paste.

5. The paper when applied to the wall to be smoothed down by a roller covered with clean flannel, and not by the hand, as the latter method completely ruins any delicate paper.

Roller.

CLXXXV.—Glazing.

1. Glass to frames of windows and doors to be of good, clear, English crown glass, 21 oz., free from flaws or bubbles, properly cut, truly bedded flush in soft putty, sprigged in with proper glazing sprigs, and firmly back puttied with good putty of whiting and linseed oil.

Glass.

2. The putty to consist of equal parts of pure linseed oil and whiting well mixed up by hand, and to be coloured to suit the appearance of the wood-work.

Putty.

CLXXXVI.—Tile Skirtings.

1. To be of Minton's or Maw's plain skirting tiles, of such colour as may be directed, set in Portland Cement; projecting ¼″ from the surface of the plastering.

CLXXXVIII.—Hoop Iron Trellis Work.

1. To consist of Hoop Iron, 1 inch broad, 18 B. W. G., weighing 1·6 lbs. per ten lineal feet, interlaced diagonally at a pitch of 45°, leaving clear openings of 2 inches square. To be secured to a light frame work of teakwood. The whole to be painted on both sides with two coats of green or other paint.

Description.

CLXXXIX.—Teakwood Trellis Work.

1. Teak battens 1″ × ½″ to be crossed diagonally in opposite directions at an angle of 45°, leaving two inch square openings between them. To be secured to the verandah posts and post plates where such exist, or to a light frame-work of teakwood. To be painted on both sides.

Descriptions.

CXC to CXCIII.—Laying Cast-iron Pipes.

See Irrigation Specification No. XXV; also Notes on Work, Pipe laying, page 310, for weight and thickness of iron piping.

PROBABLE COST OF EXECUTING WORKS ACCORDING TO THE ABOVE SPECIFICATIONS.

CLXVI.—String Course, Cutstone, 1st Sort. 6″ high, 4″ projection dressed fine.

Artificers, Labourers and Materials for 100 Running Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Stones, roughly dressed ... ... Sq. F.	125	0 4 foot	31 4			
Lime, slaked... C. F.	6	12 0 40 C. F.	1 13			
Sand, fine ... C. F.	6	2 0 100 C. F.	0 2			
Charcoal ... lbs.	75	1 0 80 lbs.	0 15			
Iron ... lbs.	4	1 0 8 lbs.	0 8			
Sundries	...	.....	0 12			
		Total Materials.	35 6			
Labour.						
Masons, for dressing ...	20	0 12 day.	15 0			
Do. setting ...	12	0 12 do.	9 0			
Nowgunnies	4	0 5 do.	1 4			
Coolies	2	0 3 do.	0 6			
Women	6	0 2 do.	0 12			
Smiths...	1¼	0 12 do.	0 15			
Bellows-boys	1¼	0 4 do.	0 5			
Bhisties	¼	0 8 do.	0 2			
Grinding chunam C. F.	6	4 0 100 C. F.	0 4			
Scaffolding	...	.....	1 0			
Sundries	...	.....	0 12			
		Total Labour...	29 12			
		Total for 100 R. F. ...	65 2		Total for 100 R. F.	

CLXVII.—String Course, Cutstone, 2nd Sort.
Same as above.

Artificers, Labourers and Materials for 100 Running Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Stones, roughly dressed ... ... Sq. F.	125	0 4 foot.	31 4			
Lime, slaked C. F.	10	12 0 40 C. F.	3 0			
Sand ... C. F.	15	2 0 100 C. F.	0 5			
Charcoal ... lbs.	60	1 0 80 lbs.	0 12			
Iron, &c. ... lbs.	3	1 0 8 lbs.	0 6			
Sundries	...	.....	0 12			
		Total Materials.	36 7			
Labour.						
Masons, for dressing ...	12	0 12 each	9 0			
Do. setting ...	10	0 12 do.	7 8			
Nowgunnies ...	4	0 5 do.	1 4			
Coolies	2	0 3 do.	0 6			
Women	6	0 2 do.	0 12			
Bhisties	¼	0 8 do.	0 2			
Smiths	1	0 12 do.	0 12			
Bellows-boys ..	1	0 4 do.	0 4			
Grinding chunam C.F.	15	3 0 100 C. F.	0 7			
Scaffolding	...	.....	1 0			
Sundries	...	.....	0 12			
		Total Labour...	22 3			
		Total for 100 R. F. ..	58 10		Total for 100 R. F...	

CLXVIII.—Coping, Cutstone, rectangular, 1st Sort. 9″ high and 1-9″ width.

Artificers, Labourers and Materials for 100 Running Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Stones, rough ...C. F.	131	0 6 C. F.	49 2			
Lime, slaked C. F.	10	12 0 40 C. F.	3 0			
Sand, fine ... C. F.	10	2 0 100 C. F.	0 3			
Charcoal... ... lbs.	160	1 0 80 lbs.	2 0			
Iron ... ... lbs.	8	1 0 8 lbs.	1 0			
Sundries	...	.....	1 0			
		Total Materials.	56 5			
Labour.						
Masons, for dressing ...	80	0 12 each.	60 0			
Do. setting ...	12	0 12 do.	9 0			
Nowgunnies	12	0 5 do.	3 12			
Coolies	2	0 3 do.	0 6			
Women	6	0 2 do.	0 12			
Bhisties	¼	0 8 do.	0 2			
Smiths...	3	0 12 do.	2 4			
Bellows-boys	3	0 4 do.	0 12			
Grinding chunam C. F.	10	4 0 100 C. F.	0 6			
Scaffolding	...	.....	1 0			
Sundries	...	.....	1 0			
		Total Labour...	79 6			
		Total for 100 R. F. ...	135 11		Total for 100 R. F....	

CLXIX.—Coping, Cutstone, rectangular, 2nd Sort.
Same as above.

Artificers, Labourers and Materials for 100 Running Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Stones, rough ...C. F.	131	0 6 foot	49 2			
Lime, slaked ...C. F.	12	12 0 40 C. F.	3 10			
Sand ... ...C. F.	18	2 0 100 C. F.	0 6			
Charcoal ... ... lbs.	120	1 0 80 lbs.	1 8			
Iron ... ... lbs.	8	1 0 8 lbs.	1 0			
Sundries	...	.....	1 0			
		Total Materials.	56 10			
Labour.						
Masons, for dressing ...	50	0 12 each.	37 8			
Do. setting ...	10	0 12 do.	7 8			
Nowgunnies	12	0 5 do.	3 12			
Coolies	2	0 3 do.	0 6			
Women	6	0 2 do.	0 12			
Bhisties	½	0 8 do.	0 4			
Smiths	2	0 12 do.	1 8			
Bellows-boys	2	0 4 do.	0 8			
Grinding chunam C. F.	18	3 0 100 C. F.	0 9			
Scaffolding	...	.....	1 0			
Sundries	...	.....	1 0			
		Total Labour...	54 11			
		Total for 100 R. F. ...	111 5		Total for 100 R.F.	

CLXX.—Coping, Cutstone, semi-octagonal, 1st Sort. 9″ high and 1-6″ broad.

Artificers, Labourers and Materials for 100 Running Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Stones, rough ... C.F.	112	0 5½ foot	38 8			
Lime, slaked ... C.F.	10	12 0 40 C. F.	3 0			
Sand ... ... C.F.	10	2 0 100 C. F.	0 3			
Charcoal ... ... lbs.	180	1 0 80 lbs.	2 4			
Iron ... ... lbs.	10	1 0 8 lbs.	1 4			
Sundries	...	.....	1 0			
		Total Materials.	46 3			
Labour.						
Masons for dressing ...	88	0 12 each.	66 0			
Do. setting ...	12	0 12 do.	9 0			
Nowgunnies	12	0 5 do.	3 12			
Coolies	2	0 3 do.	0 6			
Women	6	0 2 do.	0 12			
Bhisties	¼	0 8 do.	0 2			
Smiths	4	0 12 do.	3 0			
Bellows-boys	4	0 4 do.	1 0			
Grinding chunam C.F.	10	4 0 100 C.F.	0 7			
Scaffolding	...	.....	1 0			
Sundries...	...	.....	1 0			
		Total Labour...	86 7			
		Total for 100 R. F. ...	132 10		Total for 100R.F.	

CLXXI.—Coping, Cutstone, semioctagonal, 2nd Sort. 9″ high, 1-6″ broad.

Artificers, Labourers and Materials for 100 Running Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Stones, rough ...C. F.	112	0 5½ foot	38 8			
Lime, slaked ...C. F.	12	12 0 40 C.F.	3 10			
Sand, fine ...C. F.	18	2 0 100 C.F.	0 6			
Charcoal ... ... lbs.	140	1 0 80 lbs.	1 12			
Iron .. ... lbs.	8	1 0 8 lbs.	1 0			
Sundries	...	.....	1 0			
		Total Materials.	46 4			
Labour.						
Masons for dressing ...	58	0 12 each.	43 8			
Do. setting ...	10	0 12 do.	7 8			
Nowgunnies	12	0 5 do.	3 12			
Coolies...	2	0 3 do.	0 6			
Women	6	0 2 do.	0 12			
Bhisties	½	0 8 do.	0 4			
Smiths...	2½	0 12 do.	1 14			
Bellows-boys	2½	0 4 do.	0 10			
Grinding chunam C. F.	18	3 0 100 C.F.	0 9			
Scaffolding	...	.....	1 0			
Sundries	...	.....	1 0			
		Total Labour ...	61 3			
		Total for 100 R. F. ...	107 7		Total for 100 R. F.	

CLXXII.—Coping, Cutstone, semicircular, 1st Sort. 9″ high and 1-6″ broad.

Artificers, Labourers and Materials for 100 Running Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Stones, rough ... C. F.	112	0 5 foot.	35 0			
Lime, slaked ... C. F.	10	12 0 40 C. F.	3 0			
Sand, fine ... C. F.	10	2 0 100 C. F.	0 3			
Charcoal ... lbs.	180	1 0 80lbs.	2 4			
Iron ... ... lbs.	8	1 0 8lbs.	1 0			
Sundries	...	... ...	1 0			
		Total Materials .	42 7			
Labour.						
Masons for dressing ...	67	0 12 each.	50 4			
Do. setting ...	12	0 12 do.	9 0			
Nowgunnies ...	12	0 5 do.	3 12			
Coolies	2	0 3 do.	0 6			
Women	6	0 2 do.	0 12			
Bhisties	¼	0 8 do.	0 2			
Smiths	3	0 12 do.	2 4			
Bellows-boys ...	3	0 4 do.	0 12			
Grinding chunam. C. F.	10	4 0 100 C. F.	0 7			
Scaffolding	...	... ...	1 0			
Sundries	...	... ...	1 0			
		Total Labour ...	69 11			
		Total for 100 R. Ft. ...	112 2		Total for 100 R. F...	

CLXXII.—Coping, Cutstone, semicircular, 2nd Sort. 9″ high and 1-6″ broad.

Artificers, Labourers and Materials for 100 Running Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Stones, rough C. F.	112	0 5 foot.	35 0			
Lime, slaked C. F.	12	12 0 40 C. F.	3 10			
Sand ... C. F.	18	2 0 100 C. F.	0 6			
Charcoal ... lbs.	120	1 0 80lbs.	1 8			
Iron ... lbs.	8	1 0 8lbs.	1 0			
Sundries	...	.....	1 0			
		Total Materials.	42 8			
Labour.						
Masons for dressing ...	40	0 12 each.	30 0			
Do. setting ...	10	0 12 do.	7 8			
Nowgunnies	12	0 5 do.	3 12			
Coolies...	2	0 3 do.	0 6			
Women	6	0 2 do.	0 12			
Bhisties	½	0 8 do.	0 4			
Smiths...	2	0 12 do.	1 8			
Bellows-boys	2	0 4 do.	0 8			
Grinding chunam C. F.	18	3 0 100 C. F.	0 9			
Scaffolding		.....	1 0			
Sundries		.....	1 0			
		Total Labour...	47 3			
		Total for 100 R. Ft. ...	89 11		Total for 100 R. F...	

CLXXIV.—Stone-steps.

Should be paid as Ashlar fine or rough or block in course as the case may be.

CLXXV.—Stone-stairs.

The cost depends very much on the length of the stone; only the part out of the wall should be paid for. The rate for dressing and setting per running foot will be somewhat as follows :—for steps of section shown in Plate XIX.

If the step is 5 feet out of the wall.

Artificers, Labourers and Materials for 5 Running Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Labour.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Masons, for dressing ...	5	0 12 each.	3 12			
Do. for setting ...	2	0 12 do.	1 8			
Nowgunnies ...	4	0 5 do.	1 4			
Women	1	0 2 do.	0 2			
Smiths	¼	0 12 do.	0 3			
Bellows-boys ...	¼	0 4 do.	0 1			
Centring	...	... ...	0 8			
Sundries	...	... ...	0 2			
		Total Labour ...	7 8			
Materials.						
Stone, rough	5	1 0 per R. F.	5 0			
Other materials, such as chunam, &c., say	...	... ...	2 8			
		Total Materials.	7 8			
		For 5 Running Feet...	15 0		For 5 Running Feet.	
		or per Running Foot...	3 0		or per Running Foot.	

CLXXVI.—Wooden Staircases.

For straight strings, take annas 12 for C. F. of teak for labour.

For curved strings, take three times the price of straight strings.

One inch planking for risers, allow annas 4 for labour.

One and a half inch planking for treads, allow annas 5 for labour, including nosings.

Wooden Balusters Re. 1 to Rs. 5 per R. F., according to design.

CLXXVII.—Painting—3 Coats.

Artificers, Labourers and Materials for 100 Square Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Paint ... ... lbs.	8	16 0 Cwt.	1 2			
Linseed oil, boiled. pints.	3	2 8 gallon.	0 15			
Spirits of turpentine ... ...pints.	1	3 0 do.	0 6			
Sundries...		.....	0 5			
		Total Materials.	2 12			
Labour.						
Painters	1½	0 12 each.	1 2			
Coolies	1½	0 3 do.	0 5			
Women	2	0 2 do.	0 4			
Sundries		.....	0 3			
		Total Labour...	1 14			
		Total for 100 Sq. Ft. ...	4 12		Total for 100 Sq. F.	

CLXXVIII.—Varnishing—2 Coats.

Artificers, Labourers and Materials for 100 Square Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per.	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Varnish, Copal...pints.	3	6 0 gallon.	2 4			
Linseed oil, boiled. pints	2	2 8 do.	0 10			
Sundries	...	... ...	0 4			
		Total Materials.	3 2			
Labour.						
Painters	1½	0 12 each.	1 2			
Coolies	1½	0 3 do.	0 5			
Sundries	...	... ...	0 3			
		Total Labour...	1 10			
Total for 100 Supl. Ft. ...			4 12	Total for 100 Supl. Ft.		

CLXXIX.—White-washing—3 Coats.

Artificers, Labourers and Materials for 100 Superficial Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Lime, fine ...lbs.	6	1 4 40 lbs.	0 3			
Rice ... ...lbs.	¼	0 1 lbs.	0 ¼			
Sundries, such as earthen pots, &c ...	...	... ...	0 ¼			
		Total Materials.	0 3½			
Labour.						
Bricklayers	¼	0 10 each.	0 2½			
Coolies	¼	0 3 do.	0 ¾			
Bhisties	⅛	0 8 do.	0 1			
Sundries	...	... ...	0 ¼			
		Total Labour...	0 4½			
Total for 100 Supl. Ft., 3 coats...			0 8		Total for 100 Supl. Ft. 3 coats	

N. B.—For repairs take ⅔ of this.

CLXXX.—Yellow Wash, No. 1.

Artificers, Labourers and Materials for 100 Superficial Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Yellow earth, Mooltani. lbs.	5	0 8 40 lbs.	0 1			
Lime, fine ...lbs.	5	1 4 40 lbs.	0 2½			
Rice ... ...lbs.	¼	0 1 lbs.	0 ¼			
Sundries	...	... ...	0 ¼			
		Total Materials.	0 4			
Labour.						
Same as for Whitewashing	...	... ...	0 4½			
Total for 100 Supl. Ft ...			0 8½	Total for 100 Supl. Ft.		

N. B.—For repairs take ⅔ of this.

CLXXX (*a*).—Yellow Wash, No. 2.

Artificers, Labourers, and Materials for 100 Superficial Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Yellow ochre lbs.	½	0 4 lbs.	0 2			
Lime, fine ... lbs.	6	1 4 40 lbs.	0 3			
Rice ... lbs.	¼	0 1 lbs.	0 ¼			
Sundries	...	... ...	0 ¼			
		Total Materials.	0 5½			
Labour.						
Same as for Whitewashing	...	... ...	0 4½			
Total for 100 Supl. Ft. ...			0 10	Total for 100 Supl. Ft.		

N. B.—For repairs take ⅔ of this.

CLXXXI.—Blue Wash, No. 1.

Artificers, Labourers and Materials for 100 Superficial Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Cocoanut shells lbs.	3	0 8 40 lbs.	0 $\frac{1}{2}$			
Lime, fine ... lbs.	5	1 4 40 lbs.	0 $2\frac{1}{2}$			
Rice ... lbs.	$\frac{1}{4}$	0 1 lbs.	0 $\frac{1}{4}$			
Sundries	...	... ...	0 $\frac{1}{4}$			
		Total Materials.	0 $3\frac{1}{2}$			
Labour.						
Same as for Whitewash.	...	... ...	0 $4\frac{1}{2}$			
Total for 100 Supl. Ft. ...			0 8	Total for 100 Supl. Ft.		

N. B.—For repairs take $\frac{3}{8}$ of this.

CLXXXI (*a*).—Blue Wash, No. 2.

Artificers, Labourers and Materials for 100 Superficial Feet.	No. or quantity.	Rate.	Amount	No. or quantity	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Prussian Blue powder lbs	$\frac{1}{8}$	0 8 lbs.	0 1			
Lime, fine ... lbs.	6	1 4 40 lbs.	0 3			
Rice ... ... lbs.	$\frac{1}{4}$	0 1 lbs.	0 $\frac{1}{4}$			
Sundries	...	... ...	0 $\frac{1}{4}$			
		Total Materials.	0 $4\frac{1}{2}$			
Labour.						
Same as for Whitewash.	...	... ...	0 $4\frac{1}{2}$			
Total for 100 Supl. Ft. ...			0 9	Total for 100 Supl. Ft.		

N. B.—For repairs take $\frac{3}{8}$ of this.

CLXXXII.—Pink Wash.

Artificers, Labourers and Materials for 100 Superficial Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Vermilion ... lbs.	$\frac{1}{8}$	4 0 lbs.	0 8			
Lime, fine ... lbs.	6	1 4 40 lbs.	0 3			
Sugar ... ... lbs.	$\frac{1}{4}$	0 4 lbs.	0 1			
Glue ... ... lbs.	$\frac{1}{16}$	0 8 lbs.	0 $\frac{1}{2}$			
Sundries	...	... ...	0 $\frac{1}{2}$			
		Total Materials.	0 13			
Labour.						
Same as for Whitewash	...	... ...	0 $4\frac{1}{2}$			
		Total for 100 Supl. Ft....	1 $1\frac{1}{2}$		Total for 100 Supl,Ft.	

N.B.—For repairs take $\frac{3}{8}$ of this.

CLXXXIII.—Green Wash.

Artificers, Labourers and Materials for 100 Superficial Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
Materials.		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Green colour powder lbs.	2	0 8 lbs.	1 0			
Lime, fine lbs.	5	1 4 40 lbs.	0 2½			
Sugar lbs.	¼	0 4 lbs.	0 1			
Glue lbs.	1/16	0 8 lbs.	0 ½			
Sundries	...	... ...	0 ½			
		Total Materials .	1 4½			
Labour.						
Same as for Whitewash.	...	... ...	0 4½			
		Total for 100 Supl. Ft....	1 9		Total for 100 Supl. Ft.	

N.B.—For repairs take ⅔ of this.

CLXXXVII.—Galvanized Iron Wire Netting ½" Mesh.

Artificers, Labourers and Materials for 100 Square Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Wire netting, gal. iron S. Ft.	112	0 4 Supl. Ft.	28 0			
Teak for moulding or batten ... ...C. F.	½	3 0 C.F.	1 8			
Screws 1½" ...dozen.	10	0 3 dozen	1 14			
Sundries	...	... ...	0 4			
		Total Materials .	31 10			
Labour.						
Carpenters for moulding and fixing ...	4	0 12 each.	3 0			
Coolies	2	0 3 do.	0 6			
Sundries	...	... ...	0 4			
		Total Labour ...	3 10			
Total for 100 Supl. Feet of wire netting...			35 4	Total for 100 Supl. Ft. of wire netting.		

CLXXXVIII.—Hoop Iron Trellis Work.

Labour and Materials for 100 Square Feet.	No. or quantity.	Rate.	Amount	No or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
*Hoop iron 1″ 18 B.W.G. lbs.	128	9 8 Cwt.	10 14			
Nails 1½ inch lbs.	1½	0 3 lbs.	0 4			
Teakwood C. F.	...	3 0 C. F.	1 4			
Sundries	...	... ...	0 12			
		Total Materials.	13 2			
Labour.						
Blacksmith ...	½	0 12 each.	0 6			
Carpenters	2	0 12 do.	1 8			
Coolies	2	0 3 do.	0 6			
Sundries	...	... ...	0 4			
		Total Labour.	2 8			
		Total for 100 Square hoop iron trellis	15 10		Total for 100 Square hoop iron trellis ...	
		Add for painting both sides...	3 0		*Add* for painting both sides	
		Total Rs...	18 10		Total Rs...	

* *Note.*—The iron should be heated and rubbed over with boiled linseed oil before being worked up.

CLXXXIX.—Teakwood Trellis Work.

Labour and Materials per 100 Square Feet.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Battens 1″ × ½″ R. F.	800	0 12 100 R.F.	6 0			
Nails ... lbs.	2	0 3 lbs.	0 6			
Teakwood C. F.	½	3 0 C. F.	1 8			
Sundries	...	... ...	0 8			
		Total Materials.	8 6			
Labour.						
Carpenters	2	0 12 each.	1 8			
Coolies	2	0 3 do.	0 6			
Sawyers' work ...S. F.	20	0 12 100	0 3			
Sundries	...	... ...	0 8			
		Total Labour...	2 9			
		Total for 100 Square Feet teak trellis	10 15		Total for 100 Sq. Ft. teak trellis ...	
		Add for painting both sides.	3 0		*Add* for painting both sides	
		Total Rs...	13 15		Total Rs...	

CXC.—Laying Cast Iron Pipes, 10″ diameter.

Materials and Labour per 100 R. F.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Tons cwt. qr. lbs. Pipes weighing 2 18 0 10 including carriage by rail, &c. &c. R.F.	100	130 0 Ton	377 0			
Carting do. and hamalage Cwt.	58	0 2 Cwt.	7 4			
Joints of lead at 13 lbs. per joint No.	144⅘	0 2½ lb.	20 5			
Spun yarn lbs.	3	0 10 lb.	1 14			
Sundries, including wood, charcoal, &c....	...	... ...	6 6			
		Total Materials.	412 13			
Labour.						
Excavation of trenches C.F.	900	0 12 100 C.F.	6 12			
Filling do. do. C.F.	900	0 6 do.	3 6			
Fitters ... ...No.	2¼	0 10 each	1 6			
Blacksmith and boy No.	¼	0 12 do.	0 6			
Coolies ... ...No.	16	0 3 do.	3 0			
Women ... ...No.	3	0 2 do.	0 6			
Night watchman ...No.	1	0 3 do.	0 3			
Making up gutters and damages	...	... ...	1 9			
Sundries, including maistree, kárkúns &c.	...	... ...	3 0			
		Total Labour ...	20 0			
Total cost of 100 R. F. of pipes laid complete			432 13			
		Or per Lineal foot Rs....	4 5			

CXCI.—Laying Cast Iron Pipes, 6″ diameter.

Materials and Labour per 100 R. F.	No. or quantity.	Rate.			Amount		No. or quantity.	Rate.			Amount	
		Rs.	a.	Per	Rs.	a.		Rs.	a.	Per	Rs.	a.
Materials.												
Pipes weighing 1 ton, 8 cwt., including carriage by rail, &c. &c. ... ...R. F	100	125	0	Ton	175	0						
Carting do. and hamalage ... ... Cwt.	28	0	2	Cwt.	3	8						
Joints of lead at 6 lbs. per joint... No.	66⅔	0	2¼	lb.	9	6						
Spun yarn ... lbs.	2	0	10	lb.	1	4						
Sundries, including wood, charcoal, &c...	...		...	...	3	10						
		Total Materials			192	12						
Labour.												
Excavation of trenches ... ...C. F.	800	0	12	100C. F.	6	0						
Filling do. do....C. F.	800	0	6	do.	3	0						
Fitters ... ... No.	2	0	10	each	1	4						
Blacksmith and boy ... ... No.	½	0	12	do.	0	6						
Coolies ... ... No.	12	0	3	do.	2	4						
Women... ... No.	2	0	2	do.	0	4						
Night watchman No.	1	0	2	do.	0	2						
Making up gutters and damages	...		...	...	1	4						
		Total Labour...			14	8						
Total cost of 100 R. F. of pipes laid complete					207	4						
Or per Lineal Foot, Rs. ...					2	1						

CXCII.—Laying Cast Iron Pipes, 4″ diameter.

Materials and Labour per 100 R. F.	No. or quantity.	Rate.			Amount		No. or quantity.	Rate.			Amount	
		Rs.	a.	Per	Rs.	a.		Rs.	a.	Per	Rs.	a.
Materials.												
Pipes weighing 16 cwt. including carriage by rail, &c. &c. ...R. F.	100	125	0	Ton	100	0						
Carting do. and hamalage ... ...Cwt.	16	0	2	Cwt.	2	0						
Joints of lead at $3\frac{1}{2}$lbs. per joint ... No.	$38\frac{8}{9}$	0	$2\frac{1}{4}$	lb.	5	8						
Spun yarn ... lbs.	$1\frac{1}{2}$	0	10	lb.	0	15						
Sundries, including wood, charcoal, &c...	...		...	...	3	14						
		Total Materials			112	5						
Labour.												
Excavation of trenches ... C. F.	700	0	12	100 C. F.	5	4						
Filling do. do. C. F.	700	0	6	do.	2	10						
Fitters ... ... No.	2	0	10	each	1	4						
Blacksmith and boy No.	$\frac{1}{8}$	0	12	do.	0	4						
Coolies ... ... No.	12	0	3	do.	2	4						
Women ... ... No.	2	0	2	do.	0	4						
Night watchman ...	...		...	...	0	1						
Making up gutters and damages	...		...	...	1	4						
		Total Labour...			13	3						
Total cost of 100 R. F. of pipes laid complete		...	...	...	125	8						
Or per Lineal Foot, Rs. ...					1	4						

CXCIII.—Laying Cast Iron Pipes, 3″ diameter.

Materials and Labour per 100 R. F.	No. or quantity.	Rate.			Amount		No. or quantity.	Rate.			Amount	
		Rs.	a.	Per	Rs.	a.		Rs.	a.	Per	Rs.	a.
Materials.												
Pipes weighing 12 cwt., including carriage by rail, &c. ...R. F.	100	120	0	Ton	72	0						
Carting do. and hamalage ... ... Cwt.	12	0	2	Cwt.	1	8						
Joints of lead at 2½lbs. per joint ... No.	27 7/9	0	2¼	lb.	3	14						
Spun yarn ... lbs.	1	0	10	lb.	0	10						
Sundries, including wood, charcoal, &c....	...		...	...	2	4						
		Total Materials			80	4						
Labour.												
Excavation of trenches ... ... C. F.	600	0	8	100 C.F.	3	0						
Filling do. do. C. F.	600	0	6	do.	2	4						
Fitters ... ... No.	1½	0	10	each	0	15						
Blacksmith and boy ... ... No.	¼	0	12	do.	0	3						
Coolies ... ... No.	8	0	3	do.	1	8						
Women ... ... No.	2	0	2	do.	0	4						
Night watchman ...	...		...	...	0	1						
		Total Labour...			8	3						
Total cost of 100 R. F. of pipes laid complete					88	7						
Or per Lineal Foot, Rs. ...					0	14						

CXCIV.—Grinding Mortar.

Labour, and for preparing 100 Cubic Feet	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Pairs of bullocks ...	2	0 12 each pair	1 8			
Bhisties	1	0 8 each	0 8			
Coolies	2	0 3 do.	0 6			
Women	5	0 2 do.	0 10			
Total for preparing 100 C. F. of mortar ...			3 0		Total for preparing 100 C. F. of Mortar	

CXCV.—Tile-making—(Round).

Artificers, Labourers and Materials for 1,000.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Labour.						
Moulder	1	0 8 each	0 8			
Coolies for earth and heaping tiles, &c. ...	2	0 3 do.	0 6			
Women for covering and cutting, &c. ...	2	0 2 do.	0 4			
Sundries, such as water, &c.	...	... ...	0 1			
		Total Labour...	1 3			
Materials.						
Cart-loads of rubbish...	1½	0 8 each	0 12			
Sundries, fees, &c. ...	...	... ...	0 1			
		Total Materials	0 13			
Total for 1,000 Tiles ...			2 0		Total for 1,000 Tiles.	

CXCVI.—Brick-making on Tables.

Artificers, Labourers and Materials for 1,000 Bricks.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Making Bricks.						
Moulders	1	0 8 each	0 8			
Coolies for digging, tempering, and conveying earth, &c. ...	3	0 4 do.	0 12			
Women and boys for conveying moulded bricks, and stacking dried ones	4	0 2 do.	0 8			
Pair of bullocks for water	⅛	1 0 pair	0 2			
Sundries, such as moulds, baskets, &c .	...	... ...	0 2			
		Total Making Bricks ...	2 0			
Burning by Kiln.						
Coolies for loading kiln.	2	0 3 each	0 6			
Women do. ...	2	0 2 do.	0 4			
Firewood, dry, 28 maunds or ton ...	½	10 12 Ton	5 6			
Cooly for firing kiln ...	1	0 4 each	0 4			
Sundries	...	... ...	0 4			
		Total Burning.	6 8			
Total for 1,000 Bricks ...			8 8	Total for 1,000 Bricks.		

CXCVII.—Brick-making on Ground.

Artificers, Labourers and Materials for 1,000 Bricks.	No. or quantity.	Rate.			Amount		No. or quantity.	Rate.			Amount	
		Rs.	a.	Per	Rs.	a.		Rs.	a.	Per	Rs.	a.
Making Bricks.												
Moulders	1½	0	4	each	0	6						
Coolies for digging, tempering, and conveying earth ...	2	0	3	do.	0	6						
Women for turning and stacking dried bricks.	2	0	2	do.	0	4						
Pair of bullocks for water	⅛	1	0	do.	0	2						
Sundries, such as moulds, &c. ...	...		...	...	0	1						
		Total Making Bricks ...			1	3						
Burning by clamp.												
Coolies for loading clamp	2	0	3	each	0	6						
Women do. do...	2	0	2	do.	0	4						
Firewood, dry, 17½ maunds or ton ...	5/16	10	12	Ton	3	6						
Cowdung cakes 6 doz.	500	0	3	100	0	15						
Rubbish—cart-loads ...	2	0	8	each	1	0						
Rice husk or brushwood cart-load	½	1	0	do.	0	8						
Sundries	...		...	...	0	4						
		Total Burning.			6	11						
Total for 1,000 Bricks ...					7	14	Total for 1,000 Bricks.					

CXCVIII.—Lime-burning with Charcoal.

Artificers, Labourers and Materials for 40 Cubic Feet Slaked Lime.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Lime-stone ... C. F.	30	10 0 100	3 0			
Charcoal ... lbs.	560	1 0 80 lbs.	7 0			
Ooplas (cowdung dried) No.	125	0 4 100	0 5			
Baskets ... No.	1	0 1 each	0 1			
Sundries	...	... ...	0 1			
		Total Materials.	10 7			
Labour.						
Lime-burner	½	0 8 each	0 4			
Coolies for breaking and loading, &c. ...	5	0 3 do.	0 15			
Women do.	4	0 2 do.	0 8			
Bhisties	¼	0 8 do.	0 2			
		Total Labour ...	1 13			
Total for 1 candy or 40 C.F. of slaked lime sifted			12 4		Total for 1 candy or 40 C. F. of slaked lime sifted.	

N.B.—Unslaked stone-lime increases 1½ times in bulk when slaked, and yields 1⅓ times in bulk of pure lime.

CXCIX.—Lime-burning with Firewood.

Artificers, Labourers and Materials for 40 Cubic Feet Slaked Lime sifted.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Lime kunker, 91 maunds ...or C. F.	45	9 0 100 C. F.	4 1			
Firewood, dry ... Tons	½	10 12 Ton	5 6			
Cowdung cakes No.	125	0 4 100	0 5			
Baskets ... No.	1	0 1 each	0 1			
Sundries	...	... ...	0 1			
		Total Materials.	9 14			
Labour.						
Same as above ...	...	... ...	1 13			
Cooly, extra, for cutting wood	1	0 4 each	0 4			
		Total Labour ...	2 1			
Total for 1 candy or 40 C. F. of slaked lime sifted			11 15		Total for 1 candy or 40 C. F. of slaked lime sifted.	

One C. F. of lime kunker weighs 81 lbs.
One C. F. of unslaked kunker lime weighs 63·5 lbs.
Unslaked lime increases 1·23 times in bulk when slaked, and yields ·90 times in bulk of pure lime.
One C. F. of slaked kunker lime weighs 65·5 lbs.

CC.—Lime-burning with English Coal.

Materials and Labour.	No. or quantity.	Rate.			Amount.		No. or quantity.	Rate.			Amount.	
Materials.		Rs.	a.	Per	Rs.	a.		Rs.	a.	Per	Rs.	a.
Broken kunker ...C. F.	435	7	0	100	30	7						
*English coal ... Tons	2¼	22	0	Ton	49	8						
Carting coal to kiln ... ... Tons	2¼	1	0	do.	2	4						
Babool firewood Mds.	11	10	0	Khandi	5	8						
Cowdung cakes ... No.	300	4	0	1,000	1	3						
Sundries	...	...		...	1	8						
		Total Materials.			90	6						
Labour.												
Lime-burners ...No.	8	0	4	each	2	0						
Watchmen ...No.	8	0	3	do.	1	8						
Loading and unloading coolies ...No.	12	0	3	do.	2	4						
Do. do. women ... ...No.	4	0	2	do.	0	8						
Preparing lime, coolies ... ...No.	18	0	3	do.	3	6						
Do. do. women ... ...No.	18	0	2	do.	2	4						
Bhisties ... ...No.	6	0	8	do.	3	0						
Sundries	...	...		...	1	0						
		Total Labour ...			15	14						
Total for 435 C. F. ...	...	...		...	106	4						
Or for 1 candy or 40 C. F. of slaked lime ...					9	12						

Note.—This rate would admit of much reduction if the quantity of lime required were large, and continuous burning kilns were used. If burnt in smaller quantities than the above, the rate is a little higher.

* Price at Poona Railway Station.

CCI.—Wire Fencing.

Materials and Labour.	No. or quantity.	Rate.			Amount.		No. or quantity.	Rate.			Amount.	
		Rs.	a.	Per	Rs.	a.		Rs.	a.	Per	Rs.	a.
Materials.												
C. I. Screw bases 3′	No. 576	0	13½	each	486	0						
W. I. intermediate standards ...	No. 576	0	8¼	do.	297	0						
C.I. straining posts	No. 10	6	6	do.	63	12						
Twisted wire ...Tons	2 1/10	11	0	cwt.	445	8						
G. I. straining bolts	No. 100	0	4½	each	28	2						
Fluted keys ...	lbs. 45½	18	0	cwt.	7	5						
W. I. wedges ...	No. 576	0	½	each	18	0						
Sundries	...	...		...	15	0						
		Total Materials.			1,360	11						
Labour.												
Coolies: excavating holes for screw bases.	No. 109	0	3	each	20	7						
Do. distributing and fixing screw bases, standards and straining wire	No. 155	0	3	do.	29	1						
Muccadums ...	No. 64	0	6	do.	24	0						
Sundries	...	...		...	5	0						
		Total Labour ...			78	8						
Total cost per mile in Bombay ...					1,439	3						

Note.— Weight of Iron Work per mile.

Nos.		Tons.
576	C. I. screw bases...	7·50
576	W. I. intermediate standards	3·40
10	C. I. straining posts	0·93
20	Bundles twisted wire	2·02
100	G. I. straining bolts	0·10
2,880	Fluted keys	0·01
576	W. I. wedges	0·12
	Total ...	14·08

Cost of carriage by rail 14¼ pies per ton per mile.

CCII.—Laterite and Lime (Foundation).

Materials and Labour.	No. or quantity	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Laterite stones 30″ × 10″ × 8″ squared and delivered at site No.	72	15 0 100 No.	10 13			
Lime ... ... C.F.	12	12 0 40 C.F.	3 10			
Sand ... ... C.F.	18	2 0 100 C.F.	0 6			
Sundries	...	.....	0 12			
		Total Materials.	15 9			
Labour.						
Masons for setting No.	5	0 10 each.	3 2			
Coolies ... ... No.	6	0 3 do.	1 2			
Women ... ... No.	5	0 2 do.	0 10			
Grinding chunam. C.F.	18	3 0 100 C.F.	0 9			
Bhisties ... No.	½	0 8 each.	0 4			
Sundries	...	.....	0 12			
		Total Labour ...	6 7			
Total for 100 C. F. ...			22 0			

	Rs.	a.
Note.—Cost of stone at quarry	5	12
,, ,, dressing do.	4	12
,, ,, conveyance 3 miles	4	8
Cost of 100 stones squared and delivered ...	15	0

CCIII.—Laterite and Lime (Plinth).

Materials and Labour.	No. or quantity.	Rate,	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Laterite stones 24″ × 12″ × 8″ squared and delivered at site. No.	75	16 0 100 No.	12 0			
Lime ... ... C.F.	12	12 0 40 C.F.	3 10			
Sand ... ... C.F.	18	2 0 100 C.F.	0 6			
Sundries	...	.....	0 12			
		Total Materials.	16 12			
Labour.						
Masons for setting. No.	6	0 10 each.	3 12			
Coolies ... ... No.	5	0 3 do.	0 15			
Women ... ... No.	4	0 2 do.	0 8			
Grinding chunam. C.F.	18	3 0 100 C.F.	0 9			
Bhisties ... ... No.	½	0 8 each.	0 4			
Sundries	...	.....	0 12			
		Total Labour ...	6 12			
Total for 100 Cubic Feet ...			23 8			

Note.—

	Rs.	a.
Cost of stone at quarry	5	12
,, ,, dressing do.	5	12
,, ,, conveyance 3 miles	4	8
Cost of 100 stones squared and delivered ...	16	0

CCIV.—Laterite Superstructure (Block in course).

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs a.		Rs. a. Per	Rs. a.
Materials.						
Laterite stones 18″ × 9″ × 8″ squared and delivered at site. No.	134	9 0 100 No.	12 1			
Lime ... ... C.F.	12	12 0 40 C.F.	3 10			
Sand ... ... C.F.	18	2 0 100 C.F.	0 6			
Sundries	...	.....	0 12			
		Total Materials.	16 13			
Labour.						
Masons for setting. No.	6	0 10 each.	3 12			
Coolies ... ... No.	6	0 3 do.	1 2			
Women ... ... No	4	0 2 do.	0 8			
Grinding chunam. C.F.	18	3 0 100 C.F.	0 9			
Bhisties ... No.	½	0 8 each.	0 4			
Scaffolding	...	.....	1 0			
Sundries	...	.....	0 12			
		Total Labour...	7 15			
		Total for 100 C. F. ...	24 12			

Note.—Cost of stone at quarry ... ... Rs. 3 10
„ „ dressing do. 3 2
„ „ conveyance 3 miles 2 4

Cost of 100 stones squared and delivered 9 0

CCV.—Laterite Arching over Doors and Windows.

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Laterite stones rough 18″ × 18″ × 7″ delivered at site ... No.	100	10 0 100 No.	10 0			
Lime ... ... C. F.	12	12 0 40 C. F.	3 10			
Sand ... ... C. F.	18	2 0 100 C.F.	0 6			
Sundries	...	.....	0 12			
		Total Materials.	14 12			
Labour.						
Masons for dressing ... ... No.	16	0 10 each.	10 0			
Do. setting. No.	6	0 10 do.	3 12			
Coolies ... ... No.	6	0 3 do.	1 2			
Women ... ... No.	4	0 2 do.	0 8			
Bhisties ... ... No.	½	0 8 do.	0 4			
Carpenter ... No.	½	0 12 do.	0 6			
Grinding chunam. C. F.	18	3 0 100 C.F.	0 9			
Scaffolding	...	.....	1 0			
Sundries	...	.....	0 12			
		Total Labour...	18 5			
		Total for 100 C. F. ...	33 1			

CCVI.—Laterite Paving.

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Laterite stone dressed and delivered 12″ × 12″ × 8″ ... No.	100	8 0 100 No.	8 0			
Lime ... ...C. F.	12	12 0 40 C. F.	3 10			
Sand ... ...C. F.	18	2 0 100 C.F.	0 6			
Sundries	...	.....	0 6			
		Total Materials.	12 6			
Labour.						
Masons for setting. No.	8	0 10 each.	5 0			
Coolies ... ... No.	5	0 3 do.	0 15			
Women ... ... No.	5	0 2 do.	0 10			
Grinding chunam. C. F.	18	3 0 100 C.F.	0 9			
Bhisties ... ... No.	½	0 8 each.	0 4			
Sundries	...	.....	0 6			
		Total Labour...	7 12			
Total for 100 Superficial Feet ...			20 2			

CCVII.—Laterite Cornice 8″ high.

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Laterite stones 21″×12″×8″ delivered at site ... ... No.	120	6 4 100 No.	7 8			
Lime ... ... C. F.	12	12 0 40 C.F.	3 10			
Sand ... ... C. F.	18	2 0 100 C.F.	0 6			
Sundries	...	.....	0 12			
		Total Materials.	12 4			
Labour.						
Masons for dressing No.	10	0 10 each.	6 4			
Masons for setting. No.	6	0 10 do.	3 12			
Coolies ... ... No.	6	0 3 do.	1 2			
Women ... ... No.	4	0 2 do.	0 8			
Grinding chunam. C.F.	18	3 0 100 C.F.	0 9			
Bhisties ... ... No.	½	0 8 each...	0 4			
Sundries	...	.....	0 12			
		Total Labour...	13 3			
		Total for 100 R. F. ...	25 7			

CCVIII.—Laterite Coping, semioctagonal top, 8″ high.

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Laterite stones, rough 15″×18″×8″ delivered at site ... No.	100	6 0 100 No.	6 0			
Lime ... ... C. F.	12	12 0 40 C.F.	3 10			
Sand ... ... C. F.	18	2 0 100 C.F.	0 6			
Sundries	...	.....	0 12			
		Total Materials.	10 12			
Labour.						
Masons for dressing ... ... No.	12	0 10 each.	7 8			
Masons for setting ... ... No.	6	0 10 do.	3 12			
Coolies ... ... No.	6	0 3 do.	1 2			
Women ... ... No.	4	0 2 do.	0 8			
Grinding chunam. C. F.	18	3 0 100 C.F.	0 9			
Bhisties ... ... No.	½	0 8 each.	0 4			
Sundries	...	.....	0 12			
		Total Labour...	14 7			
		Total for 100 R. F. ...	25 3			

CCIX.—Laterite Concrete.

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Materials.						
Laterite stone metal at site (size 2″). C. F.	78	2 8 100 C.F.	2 0			
Lime, slaked ...C. F.	26	12 0 40 C.F.	7 13			
Sand ... ...C. F.	52	2 0 100 C.F.	1 0			
Sundries	...	.....	0 3			
		Total Materials.	11 0			
Labour.						
Grinding chunam C. F.	52	3 0 100 C.F.	1 9			
Coolies ... No.	4	0 3 each	0 12			
Bhisties ... No.	½	0 8 do.	0 4			
Sundries	...	.....	0 3			
		Total Labour...	2 12			
Total for 100 R. F. ...			13 12			

CCX.—Laterite Metal from Boulders.
(size 2½″)

Materials and Labour.	No. or quantity.	Rate.	Amount	No. or quantity.	Rate.	Amount
		Rs. a. Per	Rs. a.		Rs. a. Per	Rs. a.
Labour.						
Coolies for quarrying ... ... No.	2	0 3 each	0 6			
Hammerman ... No.	1	0 6 do.	0 6			
Women for breaking ... ... No.	5	0 2 do.	0 10			
Sundries	...	.....	0 2			
Total for quarrying and breaking 100 C. F.			1 8			

X.—TABLES.

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TABLE I.

Scantlings of Teak Joists at 12 inches central distance apart.

Length of Bearing in Feet.	Load 1¼ Cwt. per Square Foot.									
	Scantlings in Inches.									
	B.	D.	B.	D.	B.	D.	B.	D.	B.	D.
VI.	2	4½	2¼	4¼	2½	4	2¾	4	3	3¾
VIII.	2	6	2¼	5¾	2½	5½	2¾	5¼	3	5
X.	2	7¼	2¼	7	2½	6¾	2¾	6½	3	6¼
XII.	2	8¾	2¼	8½	2½	8	2¾	7¾	3	7½
XIV.	2	10¼	2¼	10	2½	9½	2¾	9¼	3	9
XVI.	2	11¾	2¼	11½	2½	11	2¾	10½	3	10¼
XVIII.	2	13	2¼	12¾	2½	12¼	2¾	11¾	3	11½
XX	2	14½	2¼	14	2½	13½	2¾	13	3	12¾

TABLE II,

Scantlings of Teak Joists at 12 inches central distance apart.

Length of Bearing in Feet.	Load 1½ Cwt. per Square Foot.									
	Scantlings in Inches.									
	B.	D.	B.	D.	B.	D.	B.	D.	B.	D.
VI.	2	4¾	2¼	4½	2½	4¼	2¾	4¼	3	4
VIII.	2	6¼	2¼	6	2½	5¾	2¾	5½	3	5¼
X.	2	7¾	2¼	7½	2½	7¼	2¾	7	3	6¾
XII.	2	9½	2¼	9	2½	8½	2¾	8¼	3	8
XIV.	2	11	2¼	10½	2½	10	2¾	9¾	3	9½
XVI.	2	12½	2¼	12	2½	11½	2¾	11	3	10¾
XVIII.	2	14	2¼	13½	2½	13	2¾	12½	3	12¼
XX.	2	15½	2¼	15	2½	14½	2¾	14	3	13½

Note.—Tables I to IV have been calculated from the formula for Deflection

$$D = \frac{5}{8} \times \frac{1}{16} \times \frac{L^3 \times W}{E \times bd^3}$$

in which $D = \frac{L}{40}$, and E is a constant for resistance of teak to deflection for L in feet, or Modulus of Elasticity ÷ 4 × 1728. This last has been taken as 281 in Tables I and II, and 250 in Tables III and IV.

TABLE III.—Scantlings of Teak Girders.

SPANS IN FEET.	Load 1¼ Cwt. per Square Foot.											
	Distance from centre to centre of Girders in feet.											
	5		6		7		8		9		10	
	B″	D″	B″	D″	B″	D″	B″	D″	B″	D″	B″	D′
X	5½	9¼	5¾	9¾	5¾	10¼	6	10½	6¼	10¾	6½	11
XII	6¼	10¾	6½	11¼	6¾	11¾	7	12	7¼	12½	7¼	12¾
XIV	7	12	7¼	12½	7½	13	7¾	13½	8	14	8¼	14¼
XVI	7¾	13¼	8	14	8¼	14½	8½	15	8¾	15¼	9	15¾
XVIII	8¼	14½	8¾	15¼	9	15¾	9½	16¼	9¾	16¾	10	17¼
XX	9	15¾	9½	16½	9¾	17	10¼	17¾	10½	18¼	10¾	18¾
XXII	9¾	16¾	10¼	17¾	10½	18¼	11	19	11¼	19½	11½	20
XXIV	10½	18	11	18¾	11¼	19½	11¾	20¼	12	20¾	12¼	21½

TABLE IV.—Scantlings of Teak Girders.

SPANS IN FEET.	Load 1½ Cwt. per Square Foot.											
	Distance from centre to centre of Girders in feet.											
	5		6		7		8		9		10	
	B″	D″	B″	D″	B″	D″	B″	D″	B″	D″	B″	D″
X	5¾	9¾	6	10¼	6¼	10½	6¼	11	6½	11¼	6¾	11½
XII	6½	11¼	6¾	11⅝	7	12¼	7¼	12½	7½	13	7¾	13¼
XIV	7¼	12½	7½	13¼	8	13¾	8¼	14½	8½	14½	8½	15
XVI	8	14	8½	14½	8¾	15	9	15½	9¼	16	9½	16½
XVIII	8¾	15¼	9¼	16	9½	16½	9¾	17	10¼	17½	10½	18
XX	9½	16½	10	17¼	10¼	17¾	10¾	18½	11	19	11¼	19½
XXII	10¼	17¾	10¾	18½	11	19¼	11½	19¾	11¾	2 0½	12	21
XXIV	10¾	18¾	11½	19¾	11¾	20½	12¼	21¼	12½	21¾	13	22½

Note.—The above tables have been calculated by the formula for Deflection ($\frac{1}{40}$inch per foot) with B : D : : 1 : $\sqrt{3}$.

Note.—To extend the use of Tables I to IV it may be noted that if the load per square foot be increased or decreased, or the central distance apart, then the breadth should be increased or decreased in the same proportion.

For example in Table II, if the joists be placed at 15 inches apart in a 20 feet bearing, the breath of the joist should be increased from 2 to 2½ inches for equal strength.

TABLE V.—Details of Panel Doors.

Size of Door.	Frames. Dimensions.	Frames. Length of Posts, Sills and Heads.	Frames. Cubic Contents of Frames.	Thickness of Door.	Thickness of Panel.	Width of Stile.	Do. of Lock Rail.	Do. of other Rails.	Detail of Scantlings.	Lintel to carry arch-head filling. Length.	Breadth.	Thickness.	Cubic Contents.	Best strong Brass Butt Hinges. No. of pairs.	Size	Brass Furniture. Mortice Lock.	10 in. Bolts.	8 in. Bolts.	6 in. Bolts.	Hooks and Eyes 12 in. long.
Ft.	In.	Feet.		In.	In.	In.	In.	In.	*Note.*—A small allowance is made for wastage.	Ft.	In.	In.			In.		No.	No.	No.	No.
$4\frac{1}{2}\times7\frac{1}{2}$	5 ×4	No. 2/8=16, 2/6=12, Total..28	3·89	$1\frac{1}{2}$	1	4	7	$4\frac{1}{2}$	Stiles ..4/7 ft. 7 in.=30 ft. 4 in.×4 in.=10·11 Rails ..6/2 ft. 3 in.=13 ft. 6 in.×$4\frac{1}{2}$ in.= 5·06 Do. ..2/2 ft. 3 in.= 4 ft. 6 in.×7 in.= 2·62 17·79×$1\frac{1}{2}$ in.=2·22 Panels..6/1 ft. 9 in.× 2 ft. 1 in.×1 in.. .. .. =1·82 Total c. ft. 4·04	6	$5\frac{1}{2}$	3	·69	3 prs.	$4\frac{1}{2}$	All outer doors to have mortice locks. Partition doors to have mortice latches.	2	1	..	2
4 ×7	$4\frac{1}{2}\times4$	No. 2/7½=15, 2/5½=11, Total..26	3·25	$1\frac{1}{2}$	1	4	6	$4\frac{1}{2}$	Stiles ..4/7 ft. 1 in.=28 ft. 4 in.×4 in.= 9·44 Rails ..6/2 ft. 0 in.=12 ft. 0 in.×$4\frac{1}{2}$ in.= 4·50 Do. ..2/2 0 in.= 4 ft. 0 in.×6 in.= 2·00 15·94×$1\frac{1}{2}$ in.=1·99 Panels..6/1 ft 6 in.×2 ft. 0 in.×1 in. .. .. ..=1·50 Total c. ft. 3·49	$5\frac{1}{2}$	$5\frac{1}{2}$	$2\frac{3}{4}$	·58	3 prs.	4		2	1	..	2
$\frac{1}{2}\times7$	$4\frac{1}{2}\times3\frac{3}{4}$	No. 2/7½=15, 2/5 =10, Total..25	2·93	$1\frac{1}{4}$	1	$3\frac{3}{4}$	$5\frac{1}{2}$	4	Stiles ..4/7 ft. 1 in.=28 ft. 4 in.×$3\frac{3}{4}$ in.= 8·85 Rails ..6/1 ft. 9 in.=10 ft. 6 in.×4 in.= 3·50 Do. ..2/1 ft. 9 in.= 3 ft. 6 in.×$5\frac{1}{2}$ in.= 1·60 13·95×$1\frac{1}{4}$ in.=1·45 Panels..6/1 ft. 3 in.×2 ft. 0 in.×1 in .. .. ..=1·25 Total c. ft. 2.70	5	$5\frac{1}{2}$	$2\frac{1}{2}$	·48	3 prs.	4		2	1	..	2

TABLE V.—Details of Panel Doors—*continued.*

Size of Door.	Frames. Dimensions.	Frames. Length of Posts, Sills and Heads.	Frames. Cubic Contents of Frames.	Thickness of Doors.	Thickness of Panel.	Width of Stile.	Do. of Lock Rail	Do. of other Rails.	Details of Scantlings.	Lintel to carry arch-head filling. Length.	Breadth.	Thickness.	Cubic Contents.	Best strong Brass Butt Hinges. No. of pairs.	Size	Brass Furniture. Mortice Lock.	10 in. Bolts.	8 in. Bolts.	6 in. Bolts.	Hooks and Eyes 12 in. long.
Ft.	In.	Ft. In.		In.	In.	In.	In.	In.	*Note.*—A small allowance is made for wastage.	Ft.	In.	In.	Ft.		In.			No.	No.	No.
3 ×6½	4¼×3½	No. 2/7 0=14 2/4 6= 9 Total..23	2·37	1¼	⅞	3½	5	3¾	Stiles ..4/6 ft. 7 in.=26 ft. 4 in.×3½ in.= 7·67 Rails ..6/1 ft. 6 in.= 9 ft. 0 in.×3¼ in.= 2·81 Do. ..2/1 ft. 6 in.= 3 ft. 0 in.×5 in.= 1·25 11·73×1¼″=1·22 Panels ..4/1 ft. 1 in.×2 ft. 3 in.×⅞ in.= ·71 Do. ..2/1 ft. 1 in.×1 ft. 1 in.×⅜ in.= ·17 ·88 Total c. ft. 2·10	4½	5½	2¼	·39	3 prs.	3½	All outer doors to have mortice locks. Partition doors to have mortice latches.	..	2	1	1
2½×6	4 ×3½	No. 2/6 6=13 2/4 0= 8 Total..21	2·04	1¼	1	4	6	4½	Stiles ..2/6 ft. 1 in.=12 ft. 2 in.×4 in.= 4·06 Rails ..2/1 ft. 3 in.= 2 ft. 6 in.×4½ in.= ·93 Do. ..1/1 ft. 3 in.= 1 ft. 3 in.×6 in.= ·62 5·61×1¼= ·58 Panels ..2/2 ft. 3 in.× 2 ft. 0 in.×1 in.= ·75 Do. ..2/2 ft. 9 in.× 2 ft. 0 in.×1 in.= ·91 1·66 Total c. ft. 2·24	4	5½	2	·80	1½ prs.	4		..	1	1	1

TABLE VI.—Details of Ledged Doors.

Size of Door.	Frames.			Thickness of Door.	Thickness of Battens.	Width of Battens.	Number of Battens.	Details of Scantlings.	Lintel to carry arch-head filling.				Furniture.								
	Dimensions.	Length of Posts, Sills and Heads.	Cubic Contents of Frames.						Length.	Breadth.	Thickness.	Cubic Contents.	Strong Iron Butt Hinges. No. of pairs.	Strong Iron Butt Hinges. Size.	Strong Iron Bolts. 10″.	Do. 8″.	Do. 5″.	All drop and padlock.	Iron Hooks and Eyes. 12 in long.	Iron Hooks and Eyes. 4 in. long.	Iron handle.
Ft.	In.	Ft.	Ft.	In.	In.	In.		*Note.*—A small allowance is made for wastage.	Ft.	In.	In.	Ft.		In.							
$4\frac{1}{4}\times7\frac{1}{3}$	5 ×4	No. 2/8 =16 2/6 =12 Total..28	3·89	$1\frac{1}{4}$	$1\frac{1}{8}$	3	7	No. 10 Planks ..7 ft. 7 in.×$5\frac{3}{4}$ in.×$1\frac{3}{8}$ in.=4·16 No. 1 Batten..7 ft. 7 in.=7 ft. 7 in. No. 6 do. ..2 ft. 4 in.=14 ft. 0 in. 21 ft. 7 in.×3 in.×$1\frac{1}{4}$ in.= ·56 Total c. ft. 4·72	6	$5\frac{1}{2}$	3	·69	3	$4\frac{1}{2}$	1	1	..	To one door per room.	2	1	1
4 ×7	$4\frac{1}{2}\times4$	No. $2/7\frac{1}{2}$=15 $2/5\frac{1}{2}$=11 Total..26	3·25	$1\frac{1}{8}$	1	3	7	No. 8 Planks ..7 ft. 1 in.×$6\frac{1}{4}$ in.×$1\frac{1}{2}$ in.=3·68 No. 1 Batten..7 ft. 1 in.= 7 ft. 1 in. No. 6 do. ..2 ft. 1 in.=12 ft. 6 in. 19 ft. 7 in.×3 in.×$1\frac{1}{8}$ in.= ·45 Total c. ft. 4·13	$5\frac{1}{2}$	$5\frac{1}{2}$	$2\frac{3}{4}$	·58	3	4	1	1	..		2	1	1
$3\frac{1}{3}\times7$	$4\frac{1}{3}\times3\frac{3}{4}$	NO. $2/7\frac{1}{2}$=15 2/5 =10 Total..25	2·93	1	$\frac{7}{8}$	$2\frac{3}{4}$	5	No. 8 Planks .. .. 7 ft. 1in.×$5\frac{1}{4}$ in.×$1\frac{1}{3}$ in.=2·43 No. 1 Batten ..7 ft. 1 in.=7 ft. 1 in. No. 4 do. ..1 ft. 10 in.=7 ft. 4 in. 14 ft. 5 in.×$2\frac{3}{4}$ in.×1 in.= ·28 Total c. ft. 2·71	5	$5\frac{1}{2}$	$2\frac{3}{4}$	·48	3	4	1	1	..		2	1	1

TABLE VI.—Details of Ledged Doors—*continued.*

Size of Door.	Frames.			Thickness of Door.	Thickness of Battens.	Width of Battens.	Number of Battens.	Details of Scantlings.	Lintel to carry arch-head filling.				Furniture.								
	Dimensions.	Length of Posts, Sills and Heads.	Cubic Contents of Frames.						Length.	Breadth.	Thickness.	Cubic Contents.	Strong Iron Butt Hinges. No. of pairs.	Strong Iron Butt Hinges. Size.	Strong Iron Bolts 10"	do. 8"	Do. do. 6"	Do. do.	All drop and padlock.	Iron Hooks and Eyes. 12 in. long.	Iron Hooks and Eyes. 4 in. long.	Iron Handles.
Ft.	In.	Ft.	Ft.	In.	In.	In.			Ft.	In.	In.	Ft.		In.								
3 × 6½	4¼ × 3½	No. 2/7 = 14 2/4½ = 9 Total .. 23	2·37	⅞	¾	2½	5	Ft. No. 8 Planks .. .. 6 ft. 7 in. × 4¾ fn. × 1 in. = 1·80 No. 1 Batten .. 7 ft. 1 fn. = 7 ft. 1 in. No. 4 do. .. 1 ft. 7 in. = 6 ft. 4 in. 13 ft. 5 fn. × 2½ fn. × ⅞ in. = ·20 Total c. ft. 2·00	4½	5½	2¼	·39	3	3½	..	1	1	To one door per room.	2	1	1
2½ × 6	4 × 3½	No. 2/6½ = 13 2/4 = 8 Total .. 21	2·04	¾	¾	2½	3	No. 6 Planks .. .. 6 ft. 1 in × 5½ in. × ⅞ in. × 1·16 No. 1 Batten .. 6 ft. 1 in. = 6 ft. 1 in. No. 2 do. .. 2 ft. 7 in. = 5 ft. 2 in. 11 ft. 3 in. × 2¼ in. × ⅞ in. = ·15 Total c. ft. .. 1·31	4	5½	2	·30	1½	4	..	1	1		1	1	1

TABLE VII.—Details of Glazed Windows.

Size of Window.	Frame. Dimensions.	Frame. Length of Posts, Sills and Heads.	Frame. Cubic Contents of Frames.	Width of Stiles.	Width of Rails.	Details of Scantlings of Sashes.	Number.	Length.	Total.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Thickness.	Cubic Contents.	Glass. Number.	Glass. Dimensions.	Lintel with Relieving Arch. Length.	Lintel with Relieving Arch. Breadth.	Lintel with Relieving Arch. Thickness.	Lintel with Relieving Arch. Cubic Contents.	Best strong Butt Hinges.	Brass Furniture. 9″ Bolt.	Brass Furniture. 8″ Bolt.	Brass Furniture. 6″ Bolt.	Brass Furniture. Handles.	Brass Furniture. Hooks and Eyes 12″ long.
Ft.	In.	Ft. In. Ft. In.	Ft.	In.	In.			Ft. In.	Ft. In.	Ft. In.	In.	In.	Ft.		In.	Ft.	In.	In.	Ft.	In.					
4 ×5	4 ×3½	No. 2/5½ 0 11 0; 2/5 7 11 2; Total .. 22 2	2·15	3¼	3¼	Stiles .. .. 4 5 1 20 4; Rails .. .. 4 2 0 8 0; Sash Bars, vertical 2 4 7 9 2; Do. cross .. 8 1 7¼ 12 10				28 4	3·25	1·25	·80													
										22 0	1	1·25	·19	20	10⅞×8⅝	5½	5½	2¾	·58	Prs. 2	4	1	..	2	2	2
												Total c. ft.	·99													
3½×5	4 ×3½	No. 2/5 7 11 2; 2/5 0 10 0; Total .. 21 2	2·06	3	3	Stiles .. .. 4 5 1 20 4; Rails .. .. 4 1 9 7 0; Sash Bars, vertical. 2 4 7½ 9 3; Do. cross .. 8 1 4⅝ 11 2				27 4	3	1·125	·64													
										20 5	1	1·125	·16	20	10½×7⅝	5	5½	2½	·48	Do. 2	3½	1	..	2	2	2
												Total c. ft.	·80													
3 ×4½	3½×3	No. 2/5 0 10 0; 2/4 6 9 0; Total .. 19 0	1·39	2¾	2¾	Stiles .. .. 4 4 7 18 4; Rails .. .. 4 1 6 6 0; Sash Bars, vertical. 2 4 2 8 4; Do. cross . 8 1 2¼ 9 6				24 4	2·75	1·125	·52													
										17 10	1	1·125	·14	20	9⅜×6⅜	4½	5½	2¼	·39	Do.	..	..	1	2	2	2
												Total c. ft.	·66													
3 ×4	3½×3	No. 2/4 6 9 0; 2/4 6 9 0; Total .. 18 0	1·31	2¾	2¾	Stiles .. .. 4 4 1 16 4; Rails .. .. 4 1 6 6 0; Sash Bars, vertical. 2 3 8 7 4; Do. cross .. 8 1 2½ 9 6				22 4	2·75	1	·43													
										16 10	1	1	·12	20	8¼×6⅜	4½	5½	2¼	·39	Do.	..	..	1	2	2	2
												Total c. ft.	·55													

Note.—Windows with louvered sashes to have the same thickness of frames, stiles and rails as above. Windows with iron bars to have a thickness of 2 in. and frames to be 4 in. ×4 in.

TABLE VII.—Details of Glazed Windows—*continued.*

Size of window.	Frame. Dimensions.	Frame. Length of Posts, Sills and Heads.	Frame. Cubic Contents of Frames.	Width of Stiles.	Width of Rails.	Details of Scantlings of Sashes.	Number.	Length.	Total.	Dimensions. Length.	Breadth.	Thickness.	Cubic Contents.	Glass. Number.	Glass. Dimensions.	Lintel with Relieving Arch. Length.	Breadth.	Thickness.	Cubic Contents.	Best strong Butt Hinges.	Brass Furniture. 9″ Bolt.	8″ Bolt.	6″ Bolt.	Handles.	Hook and Eye 12″ long.
Ft.	In.	Ft. In. Ft. In.	Ft.	In.	In.			Ft. In.	Ft. In.	Ft. In.	In.	In.	Ft.		In.	Ft.	In.	In.	Ft.	In					
		No.																							
		2/4 0 8 0				Stiles	2	3 7	7 2																
2½×3½	3×3	2/4 0 8 0	1·00	3	3	Rails..	2	2 6	5 0																
		Total .. 16 0								12 2	3	1	·25												
						Sash Bars, vertical.	2	3 1½	6 3																
						Do. cross ..	3	2 1½	6 4½																
										12 7½	1	1	·09	12	7⅝× 8¾	4	5½	2	·31	Pairs 1 3½	..	1	1	1	1
												Total c. ft.	·34												
		No.																							
		2/3 6 7 0				Stiles	2	3 1	6 2																
2 ×3	3×3	2/3 6 7 0	·875	2¾	2¾	Rails..	2	2 0	4 0																
		Total .. 14 0								10 2	2·75	·875	.17												
						Sash Bars, vertical.	1	2 8	2 8																
						Do. cross ..	2	1 8	3 4																
										6 0	1	·875	·04	6	9½×10	3½	5½	2	·27	,, 1 3	..	1	1	1	1
												Total c. ft.	·21												
		No.																							
		2/3 0 6 0				Stiles	2	2 7	5 2																
1½×2½	3×2½	2/3 0 6 0	·63	2½	2½	Rails..	2	1 6	3 0																
		Total .. 12 0								8 2	2½	·75	·11												
						Sash Bars, vertical.	1	2 2½	2 2½																
						Do. cross ..	2	1 2½	2 5																
										4 7½	1	·75	·02	6	6½× 8½	3	5½	2	·23	,, 3	..	1	1	1	1
												Total c ft.	·13												
		No.																							
		2/3 6 7 0				Stiles	2	1 0	2 0	2 0	2	·75	·02												
1 ×3	3×2½	2/2 6 5 0	·63	2	2½	Rails..	2	3 1	6 2	6 2	2·5	·75	·08												
		Total .. 12 0				Sash Bars, vertical.	2	0 8½	1 5	1 5	1	·75	·02	3	7½×10½	4½	5½	2½	·43	,, 3	..	..	2	1	1
												Total c. ft.	·12												

To open in one leaf.

Note.—Windows with louvered sashes to have the same thickness of frames, stiles and rails as above. Windows with iron bars to have a thickness of 2″ and frames to be 4″×4″.

TABLE VIII.

Scantlings of Teakwood Trusses 10 ft. apart for Double Tiled Roofs.

Spans.	Tie Beam.				Principals.				King Post.				Struts.				Straining Beam.				Straining Sill.				Contents of Truss.
	Length'.	Breadth".	Depth".	Contents.	Length'.	Breadth".	Depth".	Contents of two.	Length'.	Breadth".	Depth".	Contents.	Length'.	Breadth".	Depth".	Contents of two.	Length'.	Breadth".	Depth".	Contents.	Length'.	Breadth".	Depth."	Contents.	
				C. F.				C. F.				C. F.				C. F.				C. F.				C. F.	C. F.
XII ...	15	3	3	·93	$7\frac{3}{4}$	3	5	1·61	$4\frac{1}{2}$	3	6	·56	$3\frac{1}{2}$	3	$2\frac{1}{2}$	·36	...	...	...	...	...	...	...	...	3·46
XIV ...	17	3	3	1·06	9	3	$5\frac{3}{4}$	2·15	$5\frac{1}{4}$	3	6	·65	$4\frac{1}{4}$	3	$2\frac{1}{2}$	·44	...	...	..	...	...	...	...	...	4·30
No. 2																									
XVI ...	$10\frac{1}{4}$	3	$3\frac{1}{4}$	1·49	10	3	$6\frac{1}{2}$	2·70	$5\frac{3}{4}$	3	6	·71	$4\frac{3}{4}$	3	$2\frac{1}{2}$	·49	...	...	...	...	...	...	..	...	5·39
XVIII ...	$11\frac{1}{4}$	$3\frac{1}{4}$	$3\frac{3}{4}$	1·90	$11\frac{1}{2}$	$3\frac{1}{4}$	$6\frac{1}{2}$	3·50	$6\frac{1}{2}$	$3\frac{1}{4}$	6	·88	$5\frac{1}{4}$	$3\frac{1}{4}$	$2\frac{1}{2}$	·65	...	...	...	...	...	...	...	...	6·93
XX ...	$12\frac{1}{4}$	$3\frac{1}{2}$	4	2·38	$12\frac{1}{2}$	$3\frac{1}{2}$	$6\frac{3}{4}$	4·10	7	$3\frac{1}{2}$	6	1·02	6	$3\frac{1}{2}$	3	·87	...	...	...	...	...	...	...	...	8·37
XXII ...	$13\frac{1}{4}$	$3\frac{3}{4}$	$4\frac{1}{4}$	2·93	14	$3\frac{3}{4}$	7	5·10	$7\frac{1}{2}$	$3\frac{3}{4}$	6	1·17	$6\frac{1}{2}$	$3\frac{3}{4}$	$3\frac{1}{4}$	1·10	...	...	...	...	...	...	...	...	10·30
Queen Post Truss.																									
No. 2																									
XXIV ...	$14\frac{1}{4}$	4	$4\frac{1}{2}$	3·56	$9\frac{3}{4}$	4	$7\frac{1}{4}$	3·92	5	4	6	1·66	5	3	$2\frac{1}{2}$	·52	$8\frac{3}{4}$	4	6	1·45	$8\frac{3}{4}$	4	3	·72	11·83
XXVI ...	$15\frac{1}{4}$	4	$4\frac{1}{2}$	3·81	$10\frac{1}{2}$	4	$7\frac{3}{4}$	4·52	$5\frac{1}{4}$	4	6	1·75	$5\frac{1}{4}$	$3\frac{1}{4}$	$2\frac{3}{4}$	·65	$9\frac{1}{4}$	4	6	1·54	$9\frac{1}{4}$	4	3	·77	13·04
XXVIII ...	$16\frac{1}{4}$	$4\frac{1}{4}$	$4\frac{3}{4}$	4·55	$11\frac{1}{4}$	$4\frac{1}{4}$	8	5·31	$5\frac{3}{4}$	$4\frac{1}{4}$	6	2·03	$5\frac{3}{4}$	$3\frac{3}{4}$	3	·83	10	$4\frac{1}{4}$	6	1·77	10	$4\frac{1}{4}$	3	·88	15·37
XXX ...	$17\frac{1}{4}$	$4\frac{1}{2}$	5	5·39	12	$4\frac{1}{2}$	8	6·00	6	$4\frac{1}{2}$	6	2·25	6	$3\frac{3}{4}$	$3\frac{1}{4}$	1·01	$10\frac{3}{4}$	$4\frac{1}{2}$	6	2·01	$10\frac{3}{4}$	$4\frac{1}{2}$	3	1·00	17·66

Note.—These dimensions are for a roof weighing 27 lbs. per square foot with 40 lbs. more allowed for wind pressure.
For Purlins, Rafters, Ridges, &c., see Table IX.

TABLE IX.

Scantlings of Principals, Purlins, Rafters, Ridges, &c., for Double Tiled Roofs.

Spans.	Principals. Trusses, 8 Feet apart. B″	D″	Trusses, 10 Feet apart. B″	D″	Purlins. Trusses, 8 Feet apart. B″	D″	Trusses, 10 Feet apart. B″	D″	Common Rafters. At 18 inches central distance. B″	D″	At 15 inches central distance. B″	D″	Ridges. Trusses. B″	D″	8 Feet apart. Trusses. B″	D″	10 Feet apart. B″	D″	Hip Rafters. Length′.	Breadth″.	Depth″.	Contents C. F.	Jack Rafters. Length′.	Breadth″.	Depth″.	Contents C. F.	Cut Teak Battens.	Wall Plates. Under Trusses.	Under Purlins or Ridges on Partition Walls.	Under Hips.	Eave Plate.	Eave Board.
XII.	3	4	3	5	4	5¾	4¾	6¾	1¾	2¾	1¾	2½	2½	6¼	2½	7½	14	3	5¼	1·53	…	…	…	…	2 in. × ½ in.—4 in. central distance = 2·08 c. ft. per square + 5 per cent. for wastage = 2·18 c. ft. per 100 square feet.	4 pieces 2 feet × 6 in. × 4 in. = 1·33 c. ft. per truss.	1 piece 15 in. × 8 in. × 3 in. = ·21 c. ft.	1 piece 3 ft. × 8 in. × 4 in. = ·66 c. ft.	2½ in. × ⅜ in. = ·013 c. ft. rg. ft.	4 in. × 1 in. = ·0277 c. ft. rg. ft.
XIV.	3	4½	3	5¾	4¼	6	5	7	2	3	2	2¾	2½	6¾	2½	7¾	15½	3	6¼	2·10	…	…	…	…								
XVI.	3	5	3	6½	4¼	6	5	7¼	2¼	3¼	2	3	2½	7	2½	8	17	3	7	2·66	…	…	…	…								
XVIII.	3¼	5¼	3¼	6¾	4½	6¼	5¼	7¼	2¼	3¼	2¼	3¼	2½	7¼	2½	8½	18½	3	8	3·08	11½	3¼	6½	1·69								
XX.	3½	5½	3½	6¾	4½	6½	5¼	7½	2½	3¾	2½	3¾	2½	7½	2½	8¾	20	3½	9	4·37	12½	3½	7¼	2·20								
XXII.	3¾	5¾	3¾	7	4¾	6¾	5½	7¾	2¾	4	2¾	3¾	2½	7¾	2½	9¼	21½	4	9¼	5·52	14	4½	7¾	3·39								
XXIV.	4	5¾	4	7¼	4¼	6	5	7	2¼	3	2	3	2½	6¾	2½	7¾	23	4	10¼	6·55	15	4½	8¼	3·87								
XXVI.	4	6¼	4	7¾	4½	6½	5	7¼	2¼	3¼	2¼	3	2½	7	2½	8	24½	4	11½	7·83	16	5	8¾	4·86								
XXVIII.	4½	6½	4½	8	4½	6½	5¼	7½	2½	3¼	2¼	3¼	2½	7¼	2½	8½	26	4½	12	9·75	17¼	5½	9½	6·26								
XXX.	4½	6½	4½	8	4½	6½	5¼	7½	2½	3¾	2½	3½	2½	7½	2½	8¾	27½	5	12½	11·94	18¼	6	10	7·60								

Note.—These dimensions are for a roof weighing 27 lbs. per square foot with 40 lbs. more allowed for wind pressure. The scantlings of the Purlins and common Rafters have been determined by the Deflection Formula, the Deflection allowed being $\frac{1}{360}$ of an inch to a foot.

TABLE X.

Scantlings for Double Tiled Verandah Roofs.

Spans.	Principals 8′ from Centre to Centre.														Principals 10′ from Centre to Centre.													
	Verandah Posts.		Principals.				Post Plate.		Purlins.		Hips.				Principals.				Post Plate.		Purlins.		Hips.				Common Rafters.			
																											15 inches central distance.		18 inches central distance.	
	Breadth″.	Depth″.	Length′.	Breadth″.	Depth″.	Contents of 1.	Breadth″.	Depth″.	Breadth″.	Depth″.	Length′.	Breadth″.	Depth″.	Contents of 1.	Length′.	Breadth″.	Depth″.	Contents of 1.	Breadth′.	Depth″.	Breadth″.	Depth″.	Length′.	Breadth″.	Depth″.	Contents of 1.	B″	D″	B″	D″
VI...	4	4	...	...	...	...	4	6	...	...	14	3	5¼	1·53	...	...	...	...	4	7	...	...	14	3	5¼	1·53	2½	3½	2½	3¾
VII...	4	4	...	...	...	...	4	6¼	...	...	15½	3	6½	2·10	...	...	...	...	4	7¼	...	...	15½	3	6½	2·10	2¾	3¾	2¾	4
VIII...	4	4½	...	...	...	...	4	6½	...	...	17	3	7½	2·66	...	...	...	...	4	7½	...	...	17	3	7½	2·66	3	4¼	3¼	4½
VIII...	4	4½	11	3½	6¾	1·80	4	5½	3½	6¼	17	3	7½	2·66	11	3½	7½	2·00	4½	6¾	4½	7	17	3	7½	2·66	1¾	2½	1¾	2¾
IX...	4	4½	12	3½	7½	2·19	4	5¾	3½	6½	18½	3	8	3·08	12	3½	8½	2·48	4½	6¾	4½	7¼	18½	3	8	3·08	2	3	2¼	3
X...	4½	4½	13¼	3½	8½	2·74	4½	5¾	3¾	6½	20	3½	9	4·37	13¼	3¾	9	3·10	4½	7	4½	7½	20	3½	9	4·37	2¼	3	2¼	3¼
XI...	4½	4½	14¾	3½	9½	3·29	4½	5¾	4	6½	21½	4	9¼	5·52	14¼	3¾	9¾	3·62	4½	7	4½	7¾	21½	4	9¼	5·52	2¼	3¼	2½	3½

Wall plates to carry ends of rafters 4″ × 3½″.
For further particulars see Table of Scantlings for Teakwood Roofs, Table No. IX.
For single tiled verandah the scantlings for the span next less to that required may be used.

TABLE XI.

SCANTLINGS OF PRINCIPAL RAFTERS.

DOUBLE TILED ROOFING.

Clear internal Spans in Feet.

Distance apart of Trusses.	10		12		14		16		18		20		22		24		26		28		30	
	B″	D″	B″	D″	B″	D″	B″	D″	B″	D″	B″	D″	B″	D″	B″	D″	B″	D″	B″	D″	B″	D″
6′ 0″	2½	4	3	3	3	3½	3	3¾	3¼	4	3½	4¼	3¾	4¼	4	4½	4	4¾	4¼	4¾	4½	5
6 3	2½	4	3	3	3	3¾	3	3¾	3¼	4	3½	4¾	3¾	4¾	4	4½	4	5	4¼	5	4½	5
6 6	2½	4	3	3	3	3¾	3	4½	3¼	4	3½	4¾	3¾	4¾	4	4½	4	5	4¼	5	4½	5
6 9	2½	4	3	3½	3	3¾	3	4½	3¼	4½	3½	4¾	3¾	4¾	4	5	4	5½	4¼	5¾	4½	5¾
7 0	2½	4	3	3½	3	4	3	4½	3¼	4½	3½	5¼	3¾	5¼	4	5	4	5½	4¼	5¾	4½	5¾
7 3	2½	4	3	3½	3	4	3	5	3¼	4½	3½	5¼	3¾	5¼	4	5¼	4	5½	4¼	5¾	4½	6
7 6	2½	4	3	3½	3	4	3	5	3¼	5¼	3½	5½	3¾	5¾	4	5¼	4	6¼	4¼	6	4½	6½
7 9	2½	4	3	4	3	4	3	5	3¼	5¼	3½	5½	3¾	5¾	4	5¾	4	6¼	4¼	6½	4½	6½
8 0	2½	4	3	4	3	4½	3	5	3¼	5¼	3½	5½	3¾	5¾	4	5¾	4	6¼	4¼	6½	4½	6½
8 3	2½	4	3	4	3	4½	3	5½	3¼	5¼	3½	5½	3¾	5¾	4	5¾	4	6¾	4¼	7	4½	7
8 6	2½	4	3	4	3	4½	3	5½	3¼	5¾	3½	6	3¾	6¼	4	6	4	6¾	4¼	7	4½	7
8 9	2½	4	3	4½	3	5	3	6	3¼	5¾	3½	6	3¾	6¼	4	6¼	4	6¾	4¼	7	4½	7
9 0	2½	4	3	4½	3	5	3	6	3¼	5¾	3½	6	3¾	6¼	4	6½	4	7¼	4¼	7½	4½	7½
9 3	2½	4	3	4½	3	5	3	6	3¼	6¼	3½	6¼	3¾	6¾	4	6½	4	7¼	4¼	7½	4½	7½
9 6	2½	4	3	5	3	5¾	3	6½	3¼	6¼	3½	6¼	3¾	6¾	4	6½	4	7¼	4¼	8	4½	8
9 9	2½	4	3	5	3	5¾	3	6½	3¼	6¾	3½	6¾	3¾	7	4	7¼	4	7¾	4¼	8	4½	8
10 0	2½	4	3	5	3	5¾	3	6½	3¼	6¾	3½	6¾	3¾	7	4	7¼	4	7¾	4¼	8	4½	8

Example.—In a roof the span of which is 20 feet in the clear, and the trusses 7′-6″ apart, the scantlings of the principal rafter should be $3\frac{1}{2}'' \times 5\frac{1}{2}''$.

TABLE XII.

Scantlings of Teakwood Trusses 10 feet apart for Corrugated Iron Roofs.

Spans.	Tie Beam.				Principals.				King Post.				Struts.				Total C. F. of Truss.
	Length'.	Breadth".	Depth".	Contents C. F.	Length'.	Breadth".	Depth".	Contents of 2 C. F.	Length'.	Breadth".	Depth".	Contents C. F.	Length'.	Breadth".	Depth".	Contents of 2 C. F.	
XII...	15	3	3	·93	$10\frac{1}{2}$	3	4	1·75	$4\frac{1}{2}$	6	3	·56	$3\frac{1}{2}$	$2\frac{1}{2}$	2	·24	3·48
XIV...	17	3	3	1·06	$11\frac{1}{2}$	3	$4\frac{1}{2}$	2·15	$5\frac{1}{4}$	6	3	·65	$4\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{1}{4}$	·33	4·19
XVI...	No.2 $10\frac{1}{4}$	3	$3\frac{1}{2}$	1·49	$12\frac{3}{4}$	3	$4\frac{3}{4}$	2·52	$5\frac{3}{4}$	6	3	·71	$4\frac{3}{4}$	$2\frac{3}{4}$	$2\frac{1}{2}$	·45	5·17
XVIII...	$11\frac{1}{4}$	$3\frac{1}{4}$	$3\frac{3}{4}$	1·90	$13\frac{3}{4}$	$3\frac{1}{4}$	$4\frac{3}{4}$	2·94	$6\frac{1}{2}$	6	$3\frac{1}{4}$	·88	$5\frac{1}{4}$	3	$2\frac{1}{2}$	·54	6·26
XX...	$12\frac{1}{4}$	$3\frac{1}{2}$	$3\frac{3}{4}$	2·23	15	$3\frac{1}{2}$	5	3·64	7	6	$3\frac{1}{2}$	1·02	6	$3\frac{1}{4}$	$2\frac{3}{4}$	·74	7·63
XXII...	$13\frac{1}{4}$	$3\frac{1}{2}$	4	2·57	$16\frac{1}{4}$	$3\frac{1}{2}$	$5\frac{1}{4}$	4·14	$7\frac{1}{2}$	6	$3\frac{1}{2}$	1·09	$6\frac{1}{2}$	$3\frac{1}{4}$	3	·88	8·68

Note.—These dimensions are for a roof weighing 5 lbs. per square foot with 40 lbs. more allowed for wind pressure.
Purlins to be $4'' \times 5\frac{3}{4}''$ at 3 feet central distances.

TABLE XIII.

Straps and Bolts for Trusses of Roofs of various Spans.

Span of Roof.	Connecting Principal and Tie-beam.			Connecting Tie-beam and King or Queen Post.				Distance between end of strap of bolt,	
	Diameter of Bolt.	Strap.		Diameter of Bolt.	Strap.			Principal and Tie-beam.	King Post and Tie-beam.
		Thick.	Wide.		Thick.	Wide.			
XII.	$\frac{3}{4}''$	$\frac{3}{8}''$	$1\frac{1}{4}''$	$\frac{5}{8}''$	$\frac{3}{8}''$	$\frac{3}{4}''$		1′	$\frac{3}{4}''$
XIV.	$\frac{3}{4}''$	$\frac{3}{8}''$	$1\frac{1}{4}''$	$\frac{5}{8}''$	$\frac{3}{8}''$	$\frac{3}{4}''$		1′	$\frac{3}{4}''$
XVI.	$\frac{3}{4}''$	$\frac{3}{8}''$	$1\frac{1}{2}''$	$\frac{5}{8}''$	$\frac{3}{8}''$	1″	King	1′	$\frac{3}{4}''$
XVIII.	$\frac{3}{4}''$	$\frac{3}{8}''$	$1\frac{3}{4}''$	$\frac{5}{8}''$	$\frac{3}{8}''$	1″	Posts.	$1\frac{1}{4}''$	$\frac{3}{4}''$
XX.	1″	$\frac{3}{8}''$	$1\frac{3}{4}''$	$\frac{3}{4}''$	$\frac{3}{8}''$	1″		$1\frac{1}{4}''$	$\frac{3}{4}''$
XXII.	1″	$\frac{3}{8}''$	$1\frac{3}{4}''$	$\frac{3}{4}''$	$\frac{3}{8}''$	1″		$1\frac{1}{2}''$	$\frac{3}{4}''$
XXIV.	1″	$\frac{3}{8}''$	$2\frac{1}{4}''$	$\frac{3}{4}''$	$\frac{3}{8}''$	1″		$1\frac{3}{4}''$	$\frac{3}{4}''$
XXVI.	1″	$\frac{1}{2}''$	$2\frac{1}{4}''$	$\frac{3}{4}''$	$\frac{3}{8}''$	1″	Queen	$1\frac{3}{4}''$	$\frac{3}{4}''$
XXVIII.	1″	$\frac{1}{2}''$	$2\frac{1}{4}''$	$\frac{3}{4}''$	$\frac{3}{8}''$	1″	Posts.	$1\frac{3}{4}''$	$\frac{3}{4}''$
XXX.	1″	$\frac{1}{2}''$	$2\frac{1}{4}''$	$\frac{3}{4}''$	$\frac{3}{8}''$	1″		$1\frac{3}{4}''$	$\frac{3}{4}''$

N.B.—These dimensions are for a roof weighing $33\frac{1}{2}$ lbs. per square foot with 30 lbs. more allowed for wind pressure.

TABLE XIV.

Dimensions of Calicut Teak Trusses, deduced from Rules published in Vol. X. R. E. Pro-Papers, by COLONEL WADDINGTON, C.B., *Bombay Engineers, calculated by* MAJOR-GENERAL W. SCOTT.

Span Feet.	The Beam square.	Principals. Heel.	Principals. Head.	Straining Beams.	Post. King or Queen.	Struts. Upper.	Struts. Middle.	Struts. Lowest.	Ridge. Thick 2½ inches.	Pole Post / Plate. Width.	Pole Post / Plate. Depth.	Purlins. Upper. Width.	Purlins. Upper. Depth.	Purlins. Second. Width.	Purlins. Second. Depth.	Purlins. Third. Width.	Purlins. Third. Depth.	Purlins. Fourth. Width.	Purlins. Fourth. Depth.	Tie Rods. Upper. Diameter.	Tie Rods. Second Diameter.	Contents of Truss. Cubic Feet.	Feet 12.	Feet 144.	Cubic Inches.	Weight of Rods. Upper.	Weight of Rods. Lower.
XII.	2¼	4	3⅜	...	2½	1⅜ × 2	.....	.....	6¾	4	6	3¾	6	...	..	...	...	...	...	...	...	1	9	0	1	...	...
XIV.	2½	4¾	4	...	2½	2 × 2¼	.....	.....	7	4	6	4	6	...	..	...	...	...	...	...	...	2	5	9	5	...	...
XVI.	2¾	5½	4⅝	...	2½	2¼ × 2½	.....	.....	7¼	4	6¼	4	6¼	...	...	...	...	...	...	...	...	3	4	9	10	...	...
XVIII.	3	6	5⅛	...	2½	2½ × 2¾	.....	.....	7½	4¼	6¼	4¼	6½	...	...	...	...	...	...	...	...	4	6	10	0	...	...
XX.	3¼	7	6	...	2½	2½ × 3	.....	.....	7¾	4¼	6¼	4¼	6¾	...	...	...	...	...	...	...	...	6	0	5	1	...	...
XXII.	3½	7¼	6⅛	...	2½	2¾ × 3	.....	.....	8	4¼	6¼	4¼	6¾	...	...	...	..	...	...	...	...	7	7	6	11	...	...
XXIV.	3¾	5½	4⅜	4½	2½	2¼ × 2½	.....	.....	7¼	4½	6	4	6¼	4	6¼	...	...	..	...	...	...	7	10	1	10	...	...
XXVI.	4	5¾	4⅞	5	2½	2½ × 2¾	.....	.....	7¼	4½	6	4	6½	4	6⅓	...	...	...	...	...	...	9	2	2	9	...	...
XXVIII.	4	6¼	5¼	5¼	2½	2½ × 2¾	.....	.....	7¼	4½	6	4¼	6½	4¼	6½	...	...	...	...	...	...	10	9	8	2	...	...
XXX.	4¼	6¾	5⅝	5¾	2½	2¾ × 3	.....	.....	7¼	4¾	6	4¼	6¾	4¼	6¾	..	...	...	...	...	...	11	10	8	5	..	...
XXXII.	4½	5½	4⅛	4⅛	2½	3 × 3¼	2¼ × 2½	.....	7¼	4¾	5¾	4	6¼	4	6¼	4	6¼	...	...	⅜	..	14	10	11	5	14¼	...
XXXIV.	4½	5¾	4¾	4½	2½	3¼ × 3½	2¼ × 2⅝	.....	7¼	4¾	5¾	4	6½	4	6½	4	6½	...	...	⅜	...	16	0	6	9	15	...
XXXVI.	4¾	6¼	4⅝	4½	2½	3¼ × 3⅜	2½ × 2⅝	.....	7¼	5	5¾	4¼	6½	4¼	6½	4¼	6½	...	...	⅜	...	17	1	2	0	16	...
XXXVIII.	5	6½	4⅝	4½	2¾	3½ × 3¾	2½ × 2¾	.....	7¼	5	5¾	4¼	6¾	4¼	6¾	4¼	6¾	...	...	⅜	...	19	10	3	10	22	...
XL.	5	7	5⅛	4½	2¾	3½ × 4	2½ × 2¾	.....	7¼	5	6	4¼	6½	4¼	6¾	4¼	6¾	...	...	⅜	...	22	1	4	4	23	...
XLII.	5¼	6	3⅞	4½	2¾	4 × 3½	2¾ × 3	2 × 2½	7¼	5¼	5¾	4	6½	4	6½	4	6½	4	6½	⅜	⅜	26	11	4	4	23½	14
XLIV.	5½	6¼	4	4½	2¾	4 × 3¾	2¾ × 3¼	2 × 2¼	7¼	5¼	5¾	4	6½	4¼	6½	4¼	6½	4¼	6⅝	⅜	⅜	29	8	5	7	25	14½
XLVI.	5½	6½	4⅛	4½	2¾	4¼ × 3¾	3 × 3¼	2¼ × 2½	7¼	5½	5¾	4¼	6½	4¼	6¾	4¼	6¾	4¼	6¾	⅜	⅜	33	2	0	10	34¼	15¼
XLVIII.	5⅝	6¾	4¼	4½	2¾	4¼ × 4	3 × 3½	2¼ × 2½	7¼	5½	5¾	4¼	6¾	4¼	6¾	4¼	6¾	4¼	6¾	⅜	⅜	35	1	10	8	36	15¾
L.	5¾	7	4⅜	4½	3	4½ × 4	3¼ × 3½	2½ × 2⅝	7¼	5½	5¾	4¼	6¾	4¼	6¾	4¼	6¾	4¼	6¾	⅜	⅜	38	8	10	8	37	16

Note.—The scantlings given in the above Table have been found in practice to be too light, and only suited to the very best workmanship and materials.

TABLE XV.—Scantlings for Timber-topped Culverts, Single Spans.

Description of Scantlings.	4 ft. Span.					5 ft. Span.					6 ft. Span.				
	Number.	Length.	Breadth.	Depth.	Cubic Contents.	Number.	Length.	Breadth.	Depth.	Cubic Contents.	Number.	Length.	Breadth.	Depth.	Cubic Contents.
		Ft. In.	In.	In.	Ft.		Ft. In.	In.	In.	Ft.		Ft. In.	In.	In.	Ft.
Girders	6	5 6	3	5	3·44	6	6 6	3¼	5½	4·84	6	7 6	3¾	6¼	7·32
Wall plates to Girders ...	4	9 0	4	3	3·00	4	9 0	4	3	3·00	4	9 0	4	3	3·00
Railing. Sill	2	9 0	4	5	2·50	2	10 0	4	5	2·78	2	11 0	4	5	3·06
Railing. Top rail	2	4 6	4	4	1·00	2	5 6	4	4	1·22	2	6 6	4	4	1·44
Railing. Middle rail	2	4 6	4	3	·75	2	5 6	4	3	·92	2	6 6	4	3	1·08
Railing. End posts	4	3 3	4	4	1·44	4	3 3	4	4	1·44	4	3 3	4	4	1·44
Railing. Intermediate posts ...			None.					None.			2	2 6	4	4	0·55
Railing. End struts...	4	3 3	3	4	1·08	4	3 3	3	4	1·08	4	3 3	3	4	1·08
Railing. Side struts	4	2 9	3	3	·69	4	2 9	3	3	·69	6	2 9	3	3	1·03
Planking	5	11 4	8	3	9·44	6	11 4	8¾	3	12·39	6	11 4	9¼	3	13·10
Do.	5	8 2	8	3	6·80	6	8 2	8¾	3	8·93	6	8 2	9¼	3	9·44
Do. Projected to carry struts ...	2	13 4	9	3	5·00	2	13 4	9	3	5·00	3	13 4	9	3	7·50
	2	10 2	9	3	3·81	2	10 2	9	3	3·81	3	10 2	9	3	5·72
			Total	c. ft.	38·95			Total	c. ft.	46·10			Total	c. ft.	55·76

TABLE XV.—Scantlings for Timber-topped Culverts, Single Spans—*continued.*

Description of Scantlings.	8 ft. Span.					10 ft. Span.					12 ft. Span.				
	Number.	Length.	Breadth.	Depth.	Cubic Contents.	Number.	Length.	Breadth.	Depth.	Cubic Contents.	Number.	Length.	Breadth.	Depth.	Cubic Contents.
		Ft. In.	In.	In.	Ft.		Ft. In.	In.	In.	Ft.		Ft.	In.	In.	Ft.
Girders	6	9 6	$4\frac{3}{4}$	$7\frac{3}{4}$	14·57	6	12 0	$5\frac{1}{2}$	$9\frac{1}{4}$	25·44	6	14 0	$6\frac{1}{2}$	$10\frac{1}{2}$	39·81
Wall plates to girders	4	9 0	$4\frac{1}{2}$	3	3·37	4	9 0	5	$3\frac{1}{2}$	4·37	4	9 0	5	$3\frac{1}{2}$	4·37
Railing. Sill	2	13 0	4	5	3·61	2	15 0	4	5	4·17	4	9 0	4	5	5·00
Railing. Top rail	2	8 6	4	4	1·89	2	10 6	4	4	2·33	2	12 6	4	4	2·78
Railing. Middle rail	2	8 6	4	3	1·42	2	10 6	4	3	1·75	2	12 6	4	3	2·08
Railing. End posts	4	3 3	4	4	1 44	4	3 3	4	4	1·44	4	3 3	4	4	1·44
Railing. Intermediate posts ...	2	2 6	4	4	·55	2	2 6	4	4	·55	4	2 6	4	4	1·11
Railing. End struts...	4	3 3	3	4	1·08	4	3 3	3	4	1·08	4	3 3	3	4	1·08
Railing. Side struts...	6	2 9	3	3	1·03	6	2 9	3	3	1·03	8	2 9	3	3	1·37
Planking	8	11 4	10	3	18·89	10	11 4	$10\frac{1}{4}$	3	24·19	12	11 4	$9\frac{3}{4}$	3	27·62
Do.	8	8 2	10	3	13·61	10	8 2	$10\frac{1}{4}$	3	17·44	12	8 2	$9\frac{3}{4}$	3	19·91
Do. Projected to carry struts ...	3	13 4	9	3	7·50	3	13 4	9	3	7·50	4	13 4	9	3	10·00
	3	10 2	9	3	5·72	3	10 2	9	3	5·72	4	10 2	9	3	7·62
			Total	c. ft.	74·68			Total	c. ft.	97·01			Total	c. ft.	124·19

TABLE XV.—Scantlings for Timber-topped Culverts, Single Spans—*continued.*

Description of Scantlings.	15 ft. Span.					18 ft. Span.					20 ft. Span.				
	Number.	Length.	Breadth.	Depth.	Cubic Contents.	Number.	Length.	Breadth.	Depth.	Cubic Contents.	Number.	Length.	Breadth.	Depth.	Cubic Contents.
		Ft.	In.	In.	Ft.		Ft.	In.	In.	Ft.		Ft.	In.	In.	Ft.
Girders	6	17 6	7½	12½	68·36	6	21 0	8½	14½	107·84	6	23 6	9½	15½	144·18
Wall plates to girders... ...	4	9 0	6	4	6·00	8	9 0	6	4	12·00	8	9 0	6	4	12·00
Railing. Sill...	4	10 6	4	5	5·83	4	12 0	4	5	6·67	4	13 0	4	5	7·22
Railing. Top rail	2 2	11 0 6 0	4	4	3·78	4	10 0	4	4	4·44	4	11 0	4	4	4·89
Railing. Middle rail	6	5 0	4	3	2·50	8	4 6	4	3	3·00	8	5 0	4	3	3·33
Railing. End posts	4	3 3	4	4	1·44	4	3 3	4	4	1·44	4	3 3	4	4	1·44
Railing. Intermediate posts ...	4	2 6	4	4	1·11	6	2 6	4	4	1·67	6	2 6	4	4	1·67
Railing. End struts...	4	3 3	3	4	1·08	4	3 3	3	4	1·08	4	3 3	3	4	1·08
Railing. Side struts	8	2 9	3	3	1·37	10	2 9	3	3	1·72	10	2 9	3	3	1·72
Planking	15	11 4	10¼	3	36·30	20	11 4	9	3	42·50	20	11 4	10	3	47·22
Do.	15	8 2	10¼	3	26·16	20	8 2	9	3	30·62	20	8 2	10	3	34·03
Do. Projected to carry struts	4 4	13 4 10 2	9 9	3 3	10·00 7·62	5 5	13 4 10 2	9 9	3 3	12·50 9·53	5 5	13 4 10 2	9 9	3 3	12·50 9·53
			Total	c. ft.	171·55			Total	c. ft.	235·01			Total	c. ft.	280·81

TABLE XVI.—Iron Work for Timber-topped Culverts—accompaniment to Table XV.

Description.	4 and 5 ft. Spans.					6, 8 and 10 ft. Spans.					12 and 15 ft. Spans.					18 and 20 ft. Spans.				
	Number.	Length.	Breadth.	Thickness.	Weight in lbs.	Number.	Length.	Breadth.	Tickness.	Weight in lbs.	Number.	Length.	Breadth.	Thickness.	Weight in lbs.	Number.	Length.	Breadth.	Thickness.	Weight in lbs.
(*Straps to be countersunk.*)		Ft. In.	In.	In.			Ft. In.	In.	In.			Ft. In.	In.	In.			Ft. In.	In.	In.	
Securing the top rail to the end posts.	8	1 0	$1\frac{1}{4}$	$\frac{3}{16}$	6·24	8	1 0	$1\frac{1}{4}$	$\frac{3}{16}$	6·24	8	1 0	$1\frac{1}{4}$	$\frac{3}{16}$	6·24	8	1 0	$1\frac{1}{4}$	$\frac{3}{16}$	6·24
Do. do. intermediate.	..	..	none	..	..	2	1 4	$1\frac{1}{4}$	$\frac{3}{16}$	2·08	4	1 4	$1\frac{1}{4}$	$\frac{3}{16}$	4·16	6	1 4	$1\frac{1}{4}$	$\frac{3}{16}$	6·24
Holding down plates in the masonry.	4	1 0	8	$\frac{1}{4}$	26·67	4	1 0	8	$\frac{1}{4}$	26·67	4	1 0	8	$\frac{1}{4}$	26·67	4	1 0	8	$\frac{1}{4}$	26·67
Total..					32·91					34·99					37·07					39·15
Bolts.	No.	L.	Diar.	T.	Weight.	No.	L.	Diar.	T.	Weight.	No.	L.	Diar.	T.	Weight.	No.	L.	Diar.	T.	Weight.
Holding down, securing sill to masonry	8	2 0	$\frac{3}{4}$	..	23·62	8	2 0	$\frac{3}{4}$	..	23·62	8	0 2	$\frac{3}{4}$	..	23·62	8	2 0	$\frac{3}{4}$	..	23·62
Square heads and nuts to do. ..	8	·55 lbs. per pair.			4·40	8	·55 lbs. per pair.			4·40	8	·55 lbs. per pair.			4·40	8	·55 lbs. per pair.			4·40
Washers to do.	8	..	$1\frac{3}{4}$	$\frac{1}{8}$	·55	8	..	$1\frac{3}{4}$	$\frac{1}{8}$	·55	8	..	$1\frac{3}{4}$	$\frac{1}{8}$	·55	8	..	$1\frac{3}{4}$	$\frac{1}{8}$	·55
To straps securing top rail to end posts..	12	0 $4\frac{1}{2}$	$\frac{7}{16}$	..	2·26	12	0 $4\frac{1}{2}$	$\frac{7}{16}$	..	2·26	12	0 $4\frac{1}{2}$	$\frac{7}{16}$	..	2·26	12	0 $4\frac{1}{2}$	$\frac{7}{16}$	..	2·26
Do. do. intermediate do. ..	..	..	none.	..	..	2	0 $4\frac{1}{2}$	$\frac{7}{16}$	..	·38	4	0 $4\frac{1}{2}$	$\frac{7}{16}$	..	·75	6	0 $4\frac{1}{2}$	$\frac{7}{16}$	..	1·13
Bolts securing end struts to sill ..	4	1 0	$\frac{1}{2}$	..	2·62	4	1 0	$\frac{1}{2}$	..	2·62	4	1 0	$\frac{1}{2}$	..	2·62	4	1 0	$\frac{1}{2}$	..	2·62
Do. side do. top and bottom..	8	0 8	$\frac{1}{2}$	..	3·50	12	0 8	$\frac{1}{2}$	..	5·25	16	0 8	$\frac{1}{2}$	..	7·00	20	0 8	$\frac{1}{2}$	..	8·75
Strap do. posts to sill and planking	4	0 $11\frac{1}{2}$	$1\frac{1}{4}$	$\frac{3}{8}$	5·98	6	0 $11\frac{1}{2}$	$1\frac{1}{4}$	$\frac{3}{8}$	8·97	8	0 $11\frac{1}{2}$	$1\frac{1}{4}$	$\frac{3}{8}$	11·96	10	0 $11\frac{1}{2}$	$1\frac{1}{4}$	$\frac{3}{8}$	14·95
Bolts to do. through sill and post.	8	0 $4\frac{1}{2}$	$\frac{7}{16}$	..	1·51	12	0 $4\frac{1}{2}$	$\frac{7}{16}$	..	2·26	16	0 $4\frac{1}{2}$	$\frac{7}{16}$	..	3·01	20	0 $4\frac{1}{2}$	$\frac{7}{16}$	..	3·76
Add for square heads and nuts to above .. (To $\frac{1}{2}$ in. bolt. / To $\frac{7}{16}$ in bolt.) Pairs.	12	164 lbs. per pair.			1·97	16	·164 lbs. per pair.			2·62	20	·164 lbs. per pair.			3·28	24	·164 lbs. per pair.			3·94
	20	12 „ per pair.			2·40	26	12 per pair.			3·12	32	·12 lbs. per pair.			3·84	38	·12 „ per pair.			4·56
Do. Washers to above ..	32	..	$1\frac{1}{2}$	$\frac{1}{8}$	1·80	42	..	$1\frac{1}{2}$	$\frac{1}{8}$	2·36	32	..	$1\frac{1}{2}$	$\frac{1}{8}$	2·92	62	..	$1\frac{1}{2}$	$\frac{1}{8}$	3·50
Total weights lbs..					50·61					58·41					66·21					74·04

Spikes for planking 6" long 6 in one lb.	Span.	Number.	Weight in lbs.
	4	42	7
	5	48	8
	6	54	9
	8	66	11
	10	78	13
	12	96	16
	15	114	19
	13	150	25
	20	150	25

Memo. explanatory of the following Tables of Task Work in different soils.

The table has been drawn up for the purpose of determining and arranging in a systematic manner the quantities of work required as daily tasks from men, women and children engaged upon the construction of earth-work, and has proved particularly useful where large bodies of work-people, such as famine or extra-mural labour, have been employed.

The work-people should be divided into gangs, each gang consisting of fifty people—men, women and children—under one muccadum ; six gangs being placed under one mustering kárkún.

The following example illustrates the use of the Table :—

Assume a gang consisting of 20 men + 20 women + 10 children to be working with a lift varying from 6 to 10 feet and a lead varying from 200 to 300 feet *in soft muram.*

In the column including this lift and lead, the relative tasks for one man, one woman and one child is as follows :—

48, 32 and 16 cubic feet respectively—

Then $48 \times 20 = 960$ = task of 20 men
$32 \times 20 = 640$ „ „ 20 women
$16 \times 10 = 160$ „ „ 10 children

1760 cubic feet = total task to be executed by the gang, if the material were black or red soil, but as the example refers to soft muram, the multiplier, 0·82 (see foot-note to Table) must be used :

∴ Total task $= 1760 \times 0{\cdot}82 = 1443{\cdot}20$ cubic feet, and this is given to the muccadum in round numbers. Thus in the case of a puddle trench 10 feet in width the task would be given as follows :—

Length.		Width.		Depth.
140 feet	×	10 feet	×	1 foot.

In the construction of a dam where the earth is put on in layers of uniform thickness, tasks should be measured on the dam.

For breaking lumps of earth, spreading and making the layers uniform, two men should be allowed for each gang,—that is, one man for each twenty-five people employed.

In puddling, in layers of one foot in thickness, three men should complete, including cutting, treading and covering, a space of 25 feet × 10 feet or 250 cubic feet in one day.

In "ramming" with a rammer weighing 30 lbs., one man should complete 500 square feet per day.

The following Tables have reference more especially to earth-work in large dams and embankments.

TABLE XVII.

Table showing an average day's work per man, woman and child under different "lifts" and "leads" in black or red soil.

Lift, Feet.		Lead, Feet.		Average Day's Work, Cubic Feet.		
From	To	From	To	Man.	Woman.	Child.
...	5	...	50	76	51	25
inclusive.		50	100	70	47	23
		100	200	64	43	21
		200	300	59	39	20
		300	400	53	35	18
		400	500	48	32	16
		500	600	42	28	14
		600	700	36	24	12
		700	800	30	20	10
		800	900	24	16	8
		900	1,000	18	12	6
5	10	...	100	56	37	19
inclusive.		100	200	52	35	17
		200	300	48	32	16
		300	400	44	29	15
		400	500	40	27	13
		500	600	35	23	12
		600	700	31	21	10
		700	800	27	18	9
		800	900	22	15	7
		900	1,000	17	11	6
10	15	...	100	48	32	16
inclusive.		100	200	45	30	15
		200	300	41	27	14
		300	400	38	25	13
		400	500	34	23	11
		500	600	30	20	10
		600	700	27	18	9
		700	800	24	16	8
		800	900	20	13	7
		900	1,000	16	11	5
15	20	...	100	42	28	14
inclusive.		100	200	39	26	13
		200	300	36	24	12
		300	400	33	22	11
		400	500	30	20	10
		500	600	27	18	9
		600	700	24	16	8
		700	800	21	14	7
		800	900	18	12	6
		900	1,000	15	10	5

TABLE XVII—*continued.*

Table showing an average day's work per man, woman and child under different "lifts" and "leads" in black or red soil.

Lift, Feet.		Lead, Feet.		Average Day's Work, Cubic Feet.		
From	To	From	To	Man.	Woman.	Child.
20	25	...	100	37	25	12
inclusive.		100	200	35	23	12
		200	300	32	21	11
		300	400	30	20	10
		400	500	27	18	9
		500	600	25	17	8
		600	700	22	15	7
		700	800	19	13	6
		800	900	17	11	6
		900	1,000	14	9	5
25	30	...	100	33	22	11
inclusive.		100	200	31	21	10
		200	300	29	19	10
		300	400	27	18	9
		400	500	25	17	8
		500	600	23	15	8
		600	700	21	14	7
		700	800	19	13	6
		800	900	16	11	5
		900	1,000	13	9	4
30	35	...	100	30	20	10
inclusive.		100	200	28	19	9
		200	300	26	17	9
		300	400	24	16	8
		400	500	22	15	7
		500	600	20	13	7
		600	700	18	12	6
		700	800	16	11	5
		800	900	14	9	5
		900	1,000	12	8	4
35	40	...	100	28	19	9
inclusive.		100	200	26	17	9
		200	300	24	16	8
		300	400	22	15	7
		400	500	20	13	7
		500	600	18	12	6
		600	700	16	11	5
		700	800	14	9	5
		800	900	13	9	4
		900	1,000	12	8	4

TABLE XVII—*continued.*

Table showing an average day's work per man, woman and child under different "lifts" and "leads" in black or red soil.

Lift, Feet.		Lead, Feet.		Average Day's Work, Cubic Feet.		
From	To	From	To	Man.	Woman.	Child.
40	45	...	100	26	17	9
inclusive.		100	200	24	16	8
		200	300	23	15	8
		300	400	21	14	7
		400	500	20	13	7
		500	600	18	12	6
		600	700	17	11	6
		700	800	15	10	5
		800	900	13	9	4
		900	1,000	11	7	4
45	50	...	100	24	16	8
inclusive.		100	200	23	15	8
		200	300	21	14	7
		300	400	20	13	7
		400	500	18	12	6
		500	600	17	11	6
		600	700	15	10	5
		700	800	14	9	5
		800	900	12	8	4
		900	1,000	10	7	3
50	55	...	100	22	15	7
inclusive.		100	200	21	14	7
		200	300	20	13	7
		300	400	18	12	6
		400	500	16	11	5
		500	600	15	10	5
		600	700	14	9	5
		700	800	13	9	4
		800	900	12	8	4
		900	1,000	10	7	3
55	60	...	100	21	14	7
inclusive.		100	200	20	13	7
		200	300	18	12	6
		300	400	17	11	6
		400	500	15	10	5
		500	600	14	9	5
		600	700	13	9	4
		700	800	12	8	4
		800	900	10	7	3
		900	1,000	9	6	3

The above quantities must be multiplied for soft muram by 0·82 } Excavation.
Average ,, by 0·64 }
Hard ,, by 0·46 }
Loose earth or sand by ... ... 1·25 } Spoil.
Loose muram by ... ... 1·00 }

TABLE XVIII.

Task Work for General Excavation in different soils in ordinary road works.

Lead in Feet.		Lift in Feet.	Black or Red Soil, C. F.	Muram, Cubic Feet.			Loose Earth or Sand, C. F.
From	To			Soft.	Average.	Hard.	
...	50	0 to 5.	65	53	42	30	81
50	100		60	49	38	28	75
100	200		55	45	35	25	69
200	300		50	41	32	23	63
300	400		45	36	29	21	56
400	500		41	34	26	19	51
500	600		36	30	23	17	45
...	100	5 to 10.	48	39	31	22	60
100	200		44	36	28	20	55
200	300		41	34	26	19	51
300	400		38	31	24	17	48
400	500		34	28	22	16	43
500	600		30	25	19	14	38
...	100	10 to 15.	41	34	26	19	51
100	200		38	31	24	17	48
200	300		35	29	22	16	44
300	400		33	27	21	15	41
400	500		29	24	19	13	36
500	600		26	21	17	12	33
...	100	15 to 20.	36	30	23	17	45
100	200		33	27	21	15	41
200	300		31	25	20	14	39
300	400		28	23	18	13	35
400	500		26	21	17	12	33
500	600		23	19	15	11	29

Note.—A woman can perform $\frac{2}{3}$ work of man.
Each child do. $\frac{1}{2}$ do. of woman.

TABLES FOR ASCERTAINING COST OF CARRIAGE BY COOLIES AND CARTS.

Memorandum on Cost of Carriage.

When any quantity of materials of given weight or cubic content *(L)* has to be moved to any distance *(d)*, in feet, by a succession of trips of a number of units of conveyance, whose load in lbs. or cubic feet is *(l)*, then the cost of transport of *(L)* will depend

1stly, on X, or the proportion of *(L)* to *(l)*; that is, the number of unit-loads, or trips of a unit of conveyance, that will be necessary.

2ndly, on Y, or the fraction of a working day, taken by a unit to make one trip to *(d)* and back.

3rdly, on Z, or the hire of a unit of conveyance for a working day.

In fact the cost of transport will $= X \times Y \times Z$.

To make tables for all possible values of Z would be beyond the scope of this memorandum. The following tables, however, give some useful values of Y for various leads, also of $X \times Y$ for a few given values of X or $\frac{L}{l}$

The calculation of Y requires the following data :—

M, the number of minutes in a working day.

t, the time in minutes taken to load and unload a unit.

*s, the average speed in feet per minute of a unit. If also for convenience of notation.

T, represent the time in minutes taken for a unit to make one trip to *(d)* and back.

N, be the number of such trips made in a working day.

then (1) $$T = \frac{2d}{S} + t.$$

(2) $$N = \frac{M}{T} = \frac{M}{\frac{2d}{S} + t.}$$

(3) $$Y = \frac{T}{M} = \frac{\frac{2d}{S} + t}{M} = \frac{I}{N}$$

* *Note.*—S, the average speed, is the harmonic mean between the observed or known speeds s' s'' of the unit when loaded and unloaded respectively, i.e. $= \frac{2 s' s''}{s' + s''}$

If T be observed as well as t, then from (1) $S = \frac{2d}{T - t.}$

TABLE XIX.

When unit of conveyance=COOLY LOAD, or $l=\frac{1}{2}$ cubic foot.
DATA: M=500 minutes, $t=\frac{1}{2}$ minute, s=200 feet, d as per column I.,
Formulæ $T=\frac{2d}{s}+t$; $N=\frac{M}{T}$; $Y=\frac{T}{M}$; $X=\frac{L}{l}$; Z=daily hire of unit.
Cost of transport of quantity L to d=X × Y × Z.

I.	II.	III.	IV.	V.	I.	II.	III.	IV.	V.
Lead or distance in feet.	No. of trips to d. and *back* in a day.	Time of a trip to d. and back in minutes.	Fraction of a day taken to make one trip to d and back expressed in decimals.	X × Y when $l=\frac{1}{2}$ C.F. $L=100$ cubic feet *i.e.* X × Y = 200 Y.	Lead or distance in feet.	No. of trips to d. and back in a day.	Time of a trip to d and back in minutes.	Fraction of a day taken to make one trip to d and back expressed in decimals.	X × Y when $l=\frac{1}{2}$ C.F. $L=100$ cubic feet *i.e.*, X × Y = 200 Y.
d.	N.	T.	Y.	X×Y.	d.	N.	T.	Y.	X×Y.
20	714	·70	·0014	·28	475	95	5·25	·0105	2·10
30	625	·80	·0016	·32	500	91	5·50	·0110	2·20
40	556	·90	·0018	·36	525	87	5·75	·0115	2·30
50	500	1·00	·0020	·40	550	83	6·00	·0120	2·40
60	455	1·10	·0022	·44	575	80	6·25	·0125	2·50
70	417	1·20	·0024	·48	600	77	6·50	·0130	2·60
80	385	1·30	·0026	·52	625	72	6·75	·0135	2·70
90	357	1·40	·0028	·56	650	71	7·00	·0140	2·80
100	333	1·50	·0030	·60	675	69	7·25	·0145	2·90
125	286	1·75	·0035	·70	700	67	7·50	·0150	3·00
150	250	2·00	·0040	·80	750	63	8·00	·0160	3·20
175	222	2·25	·0045	.90	800	59	8·50	·0170	3·40
200	200	2·50	·0050	1·00	850	56	9·00	·0180	3·60
225	182	2·75	·0055	1·10	900	53	9·50	·0190	3·80
250	167	3·00	·0060	1·20	950	50	10·00	·0200	4·00
275	154	3·25	·0065	1·30	1000	48	10·50	·0210	4·20
300	143	3·50	·0070	1·40	1050	45	11·00	·0220	4·40
325	133	3·75	·0075	1·50	1100	43	11·50	·0230	4·60
350	125	4·00	.0080	1·60	1150	42	12·00	·0240	4·80
375	118	4·25	.0085	1·70	1200	40	12·50	·0250	5·00
400	111	4·50	.0090	1·80	1250	38	13·00	·0260	5·20
425	105	4·75	·0095	1·90	1300	37	13·50	·0270	5·40
450	100	5·00	·0100	2·00	1320	36·5	13·75	·0275	5·50

N.B.—Quantity carried in a day is N unit-loads.
Cost of carrying one cooly load to d=Y × hire of cooly; of 100 C. F. of any materials is X × Y × hire of cooly.

Example.

What would be cost of removing 100 C. F. to 600 feet if coolies cost 3 annas a day.

Ans. 2·6 × 3=7·8 annas.

TABLE XX.

When unit of conveyance = CART LOAD or l has the values in Columns V to XII.
DATA: M = 540 minutes. t = 10 minutes. s = 100 feet. d as per column I.
Formulæ: $T = \frac{2d}{s} + t$; $N = \frac{M}{T}$; $Y = \frac{T}{M}$; $X = \frac{L}{l}$; Z = daily hire of unit,
Cost of transport of quantity L to d = X × Y × Z.

d.	N.	T.	Y.	X × Y for the undermentioned Value of L and l.							
				L = 100 Cubic Feet.					L = 1 Ton.		
Lead or Distance in feet.	No. of trips to d and back in a day.	Time of a trip to d and back in minutes.	Fraction of a day taken to make one trip to d and back expressed in decimals.	l. in C. F. 6.	l. in C. F. 7.	l. in C. F. 8.	l. in C. F. 9.	l. in C. F. 10.	l. in cwt. 8.	l. in cwt. 9.	l. in cwt. 10.
I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.
400	30	18	·0333	·556	·476	·416	·370	·333	·0825	·0730	·0666
431	29	18·6	·0345	·575	·493	·431	·383	·345	·0863	·0766	·0690
482	28	19·6	·0357	·595	·510	·446	·397	·357	·0895	·0793	·0714
500	27	20	·0370	·617	·529	·463	·411	·370	·0925	·0826	.0740
540	26	20·8	·0384	·640	·549	·480	·427	·384	·0960	·0853	·0768
580	25	21·6	·0400	·666	·572	·500	·444	·400	·1000	·0889	·0800
625	24	22·5	·0416	·693	·594	·520	·416	·416	·1040	·0925	·0832
675	23	23·5	·0435	·724	·621	·544	·483	·435	·1087	·0966	·0870
730	22	24·5	·0454	·757	·649	·567	·504	·454	·1135	·1009	·0908
785	21	25·7	·0476	·793	·680	·595	·529	·476	·1202	·1068	·0952
850	20	27	·0500	·833	·714	·625	·555	·500	·1250	·1111	·1000
921	19	28·4	·0526	·877	·751	·657	·584	·526	·1315	·1169	·1052
1,000	18	30	·0555	·925	·793	·694	·617	·555	·1389	·1234	·1111
1,088	17	31·8	·0588	·980	·840	·735	·653	·588	·1470	·1307	·1176
1,188	16	33·7	·0625	1·042	·893	·781	·694	·625	·1560	·1390	·1250
1,300	15	36	·0666	1·111	·952	·833	·740	·666	·1666	·1480	·1330
1,428	14	38·5	·0714	1·190	1·020	·893	·793	·714	·1787	·1590	·1430
1,575	13	41·5	·0769	1·282	1·099	·961	·854	·769	·1925	·1710	·1540
1,750	12	45	·0833	1·389	1·190	1·042	·926	·833	·2080	·1850	·1660
1,955	11	49	·0909	1·515	1·299	1·136	1·010	·909	·2280	·2020	·1820
2,200	10	54	·1000	1·666	1·429	1·250	1·111	1·000	·2500	·2220	·2000
2,500	9	60	·1111	1·852	1·587	1·389	1·234	1·111	·2770	·2470	·2220
2,675	8·5	63·5	·1176	1·960	1·680	1·470	1·307	1·176	·2940	·2610	·2350
2,875	8	67·5	·1250	2·083	1·786	1·563	1·389	1·250	·3130	·2770	·2500
3,100	7·5	72	·1333	2·222	1·904	1·666	1·481	1·333	·3330	·2960	·2660
3,355	7	77	·1428	2·383	2·040	1·784	1·587	1·428	·3560	·3170	·2850
3,653	6·5	83	·1538	2·563	2·197	1·922	1·709	1·538	·3840	·3410	·3070
4,000	6	90	·1666	2·777	2·381	2·083	1·852	1·666	·4170	·3700	·3330
4,425	5·5	98·5	·1818	3·030	2·597	2·273	2·020	1·818	·4540	·4030	·3630
4,900	5	108	·2000	3·333	2·857	2·500	2·222	2·000	·5000	·4450	·4000
5,500	4·5	120	·2222	3·703	3·174	2·777	2·469	2·222	·5550	·4940	·4440
6,200	4	135	·2500	4·166	3·571	3·125	2·777	2·500	·6250	·5560	·5000
7,200	3·5	154	·2857	4·762	4·082	3·573	3·174	2·857	·7140	·6340	·5710
8,500	3	180	·3333	5·555	4·762	4·167	3·704	3·333	·8330	·7410	·6660
10,300	2·5	216	·4000	6·666	5·714	5·000	4·444	4·000	1·000	·8890	·8000
13,000	2	270	·5000	8·333	7·143	6·250	5·555	5·000	1·250	1·111	1·000
17,500	1·5	360	·6666	11·111	9·524	8·333	7·407	6·666	1·670	1·480	1·333
26,500	1	540	1·000	16·666	14·286	12·500	11·111	10·00	2·500	2·220	2·000
53,500	0·5	1,080	2·000	33·333	28·572	25·000	22·222	20·00	5·000	4·440	4·000

Example.

Cost of carrying 100 cubic feet metal 2,200 feet, if cart hired at 12 as. a day takes 8 cubic feet as its load, = 1·25 × hire of cart per day = 1·25 × 12 = 15 as.

XI.—NOTES.

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XI.—NOTES.

Stone.

The principal stones used for building purposes in the Bombay Presidency are :—

Blue Basalt or Trap.—This varies much in quality. The best quality is hard, of a bright colour, breaking with a clean fracture, and ringing when struck with a hammer, well suited for paving and metalling roads. Weight per cubic foot being 187·5 lbs.

Bombay Basalt, which is very hard and good, gives a resistance to crushing of 12,548 lbs. per square inch.

Inferior qualities are often much softer and easier to work, but in a few years become discoloured, and decay rapidly. When stone from boulders is used, great care should be taken not to admit stones that peel, as some stone of this class, though perfectly sound to look at, peels like an onion after a few months' exposure to the weather.

Yellow Basalt.—Obtained at Kúrla on the G. I. P. Railway; resistance to crushing, 12,219 lbs. per square inch.

Red Basalt.—From Satry or from near Talegaon in the Poona Districts.

Hemnuggur.—Obtained about 40 miles from Ahmedabad. A moderately hard, fine-grained silicious sandstone. Resistance to crushing, 5,125 lbs. per square inch.

Porebunder.—A calcareous grit, composed of formaniferous shells and a few grains of quartz, joined by solution of shells and re-crystallization. Good Porebunder stone should be of fine grain, good colour, and free from salt, with no black specks in it; and if it has been at any time saturated with sea water, it should be rejected. Great care should be taken to lay it on its natural bed in the work. Resistance to crushing, 2,451 lbs. per square inch.

Granite.—Excellent granite is obtainable in Kánara, but it is difficult and expensive to work.

Laterite.—A clay-stone impregnated with iron in the form of red and yellow ochres, with a perforated and cellular structure, is obtained in Belgaum, Ratnágiri, Kánara, Dhárwár, and Mahábaleshvar. It is very easy to work, but care is required in selection of stone, as the inferior sorts decay rapidly when exposed to the weather.

Limestone.—A splendid limestone obtained in layers from 3 inches to 15 inches in thickness is found at Sháhábad on the G. I P. Railway, but the expense of carriage by rail almost precludes its use.

Sandstone, sienite, slate, and ironstone are met with in the Southern Marátta Country.

Brickwork.

Colouring by dipping.—Bricks or tiles coloured in this way are said to stand any amount of exposure to the weather without losing their colour, and the surface of such a brick will never take on any vegetable matter when exposed to a damp atmosphere. The materials used for the colouring liquid are turpentine, linseed-oil, and litharge, with colouring matter as may be required.

An earthenware box is provided, a few inches larger each way than a common brick, and it is half filled with liquid of about the consistency of thick cream. The bricks to be coloured are laid upon an iron plate with a fire underneath, and heated, not to a great heat, but too great to admit of their being handled. They are then taken one at a time and dipped into the liquid for a few seconds, then placed on a table to dry, which they do in a few minutes. They are then taken and slightly washed in cold water, and placed aside to dry. In open and porous bricks the colouring matter will penetrate about $\frac{1}{8}$ of an inch. The following are the proportions used for some of the colours :—

I.—For Dark Red Bricks.

$1\frac{1}{2}$ pints of turpentine.
$1\frac{1}{2}$ „ linseed-oil.
$\frac{1}{4}$ lb. of litharge.
$\frac{1}{2}$ oz. of Indian red.
Mix well together and use as above.

II.—For Blue Bricks.

1 pint of turpentine.
1 „ linseed-oil.
$\frac{1}{2}$ oz of litharge.
1 lb. of French ultramarine.

III.—For Black Bricks.

2 ozs. of litharge.
6 „ manganese.
4 „ linseed-oil, boiled.
6 „ turpentine.

IV.—For Grey Bricks.

3 ozs. of white lead.
1 oz. of litharge.
1 „ manganese.
2 ozs. of boiled linseed-oil.
4 „ turpentine.

These colours may also be applied to walls already built. In such a case the bricks are carefully cleaned, and the liquid heated and laid on with a brush.

Terra Cotta.—This material is now much used in England for frieze in cornice, mouldings, panels, &c., and might be introduced more frequently into buildings in this country with great advantage.

It could probably be delivered in Bombay, at about the following prices, including packing*:—

Round columns in 18-inch lengths, 12-inch diameter with base caps to drawings included, complete, net per foot running	Pilasters in 18-inch lengths 12 × 12 inch with base and cap complete, net per foot running.	Other Terra Cotta goods not more than 1 foot cubic, or 18 inches long.
Plain at 5s., fluted or ribbed 5/6, moulded, twisted, foliated, or otherwise ornamented 6/6.	Plain 5/6, moulded or panelled 6/, panelled or otherwise ornamented 7/.	Net per cubic foot ordinary pattern 5s., extra or ornamented patterns, or larger sizes not being more than 24 feet long, from 6s. to 7/6 per cubic foot.

All columns and pilasters would be rebated, fitted, and numbered and all other goods would also be fitted and numbered, so that they could readily be fixed without skilled labour.

Hollow Walls.—Examples of these made with ordinary bricks are given on the plates on brickwork. The advantages of this method of construction are economy, lightness, freedom from damp, and, in this country, probably coolness.

Brick Nogging and Teak Posts.—This is an excellent, cheap, and very desirable mode of construction, and might be frequently adopted for civil buildings in the mofussil with great advantage. A fair estimate for single-storied buildings of this class finished complete in Bombay is from Rs. 3 to 4 per superficial foot of ground covered. (See Specification No. XLV.)

Tiled Walls.—A very good method of protecting brick or other walls much exposed to rain, is by nailing battens to the wall, and on to these fixing small flat tiles, either square or fancy shaped, fixed in the same manner as slates. In the south of England houses are often built in this manner, the roof, &c., being supported on wooden posts, to which the exterior battens carrying the tiles are fixed, a space being left between them and the interior battens to which the plaster is applied. The effect is neat and picturesque, and cost very moderate.

Laying Bricks.—In foundations and other walls where joints are left rough, an English bricklayer can lay 1,500 to 1,600 bricks in 10 hours; but where facework has to be worked fair, not more than 1,000; and in walls carefully jointed and faced with picked bricks, not more than 500, provided it is straight walling without many openings.

* From Messrs. Gibbs and Canning, Tamworth.

Plasters, Cements, &c.

Madras Plaster.—From Specification by Colonel Fuller, R.E. The finishing coats to be as follows :—

Two coats, of a mixture of powdered China 2 parts, powdered marble 1 part, and fine lime to be laid on and rubbed into the plaster, each coat for 2 consecutive days. The China and marble powders to be freed from dust, which is to be reserved for after-coatings.

Two coats, of China powder 1 part, and marble 2 parts, as above, each coat being well rubbed in for one day.

Two coats of "Turree" finely shifted shell lime to be laid on and well rubbed until the required polish is obtained. A small quantity of gum or white of egg to be used in the last 2 coats.

Mogul Mortar.—(Khándesh).

To 1 pucka khandi fine chunam (80 C. F.)

add 10 C. F. Sand.
12 lbs. Jagree.
8 „ Heerda.
8 „ Googul.
6 „ Caoutchouc.
10 „ Hemp.
6 „ Gum.

Oil Cement.—For laying earthenware pipes,

5 lbs. dry slaked lime,
1 lb. oil by weight,

pounded in stone mortar with iron pestle, for 6 hours, to reduce it to a thick paste for use.

Durable Cement.—For steam and water joints. Take 10 lbs. of ground litharge, 4 lbs. ground Paris white, ½ lb. yellow ochre, 2 lbs. red lead, ½ oz. of hemp, cut into ½ inch lengths. Mix all together into boiled linseed-oil to the consistency of very stiff putty. Make the joint in the usual way.

Useful Cement.—For reservoirs, cisterns, &c. Take 90 parts of well-burnt brick (fire-brick is best), 10 parts of litharge, well pulverised and mixed together to consistency of plaster, with boiled linseed-oil. Use in same way as plaster, previously wetting the parts to be covered with water. In 3 or 4 days the cement will become hard.

Waterproof Mastic Cement.—Molesworth.

1 red lead,
4 ground lime,
5 sharp sand, mixed with boiled oil,
or 1 red lead,
5 whiting,
10 sharp sand, mixed with boiled oil.

Rust Joint Cement.—(Quickly setting).

1 sal ammoniac in powder (by weight),
2 flower of sulphur,
80 iron borings,

made to a paste with water.

Rust Joint.—(Slowly setting).

2 sal ammoniac,
1 flower of sulphur,
200 iron borings.

The latter cement is the best if the joint is not required for immediate use.

Red Lead Cement.—(For face joints).

1 oz. white lead,
1 „ red lead,

mixed with linseed oil to the proper consistency.

Glue.—To resist moisture 1 lb. glue melted in 2 quarts of skimmed milk. When strong glue is required, add powdered chalk to common glue.

Marine Glue.—1 of India rubber, 12 mineral naptha or coal tar; heat gently, mix, and add 20 of powdered shellac. Pour out on a slab to cool; when used to be heated to about 250°.

Quick Drying Glues.—1*st.* Break up the glue, dissolve in common whisky or spirit of any sort without heat. Cork tight. It will keep for years.

2*nd.*—Shellac dissolved in methylated spirits, or French glue in acetic acid.

Glue Cements.—(to resist moisture.)

1*st.*—1 glue,
1 black rosin,
½ red ochre.
} Mixed with the least possible quantity of water.

2*nd.*—4 of glue.
1 of boiled oil by weight.
1 oxide of iron.

Liquid Glue.—Mix 4 parts of treacle with 12 parts of water by weight, and add 1 part of quick lime; heat to about 150° Fah. and afterwards macerate for two or three days with frequent agitation. Decant from the undissolved lime, the solution having the consistency of mucilage. Add to the solution ¼th of its weight of glue and 3 per cent. of glycerine. This makes a good strong liquid glue.

To fill Cracks in Terraced Roofs—

2 parts linseed-oil (raw),
2 „ rosin,
1 „ pumice if obtainable; if not, use fine sand.

Boil oil, pound pumice and mix with pounded rosin; put in these whilst hot, and mix till a stick will almost stand upright. (Add rosin if above is not sufficient.) The cracks should not be disturbed

or dug out with a trowel, but the liquid mixture poured in and surface smoothed over.

To stop Leakage in Aqueducts.—The Executive Engineer for Irrigation, Poona, states that 2 coats of oxide of iron paint on top of the plastered arches on the Mutha Canal stopped their leaking.

Dr. O'Shaughnessy's Cement.—The composition used in this country for the protection of telegraph wires laid underground, consists of 120 parts (by weight) of pure resin (American) and 300 sand; it has been recommended for the lining of cisterns and other building purposes, and the following is Dr. O'Shaughnessy's description of the manner of using it for coating floors, cisterns, &c.:—

The resin is melted in an iron vessel, the sand stirred in and well incorporated with an iron stirrer, and the whole poured when of the consistence of treacle. Great care must be taken to prevent the resin from taking fire, or charring, by too prolonged or too high a heat.

The cement thus prepared may be cast into bricks or tiles, or poured on floors or roofs or on planked flooring, to all of which it firmly adheres. Joints are readily and securely made by pouring a little melted resin or pitch into the line of juxtaposition of the bricks or tiles, and cracks are filled up in the same simple way.

A tile of this kind 12 inches square and 1½ inches thick weighs 387 tolas. If carefully prepared, this cement is totally impermeable to water, and is not affected by the fiercest solar heat. It withstands dead pressure better than common bricks or tiles.

The composition is brittle, so that for roofing or flooring purposes it is very much improved by slips of bamboo being inserted in it while soft. A very coarse Durmah mat placed on its surface while still soft is a great improvement to it for flooring purposes, and if used in a thoroughfare, a thin layer of sand or road dust laid over it while hot will be found to preserve the surface from abrasion. It need scarcely be pointed out, that notwithstanding the unquestionable and remarkable advantages derivable from the use of this cement, it is open to the very serious objection of being dangerous in cases of fire.

Concrete for Sea Works.—Concrete has been largely used in the form of blocks in the superstructure of the Manora Breakwater, Karáchi Harbour Works. The size of the blocks was 16 cubic yards, weighing 27 tons each, and the composition as follows:—

	Cubic Feet.
Portland Cement	44*
River sand	180
Shingle	252
Quarry lumps, conglomerate, 14 to 28 lbs. each	144
Salt water (liable to slight variation according to weather)	432 gallons.

* Indian bulk; see Roorkee Professional Papers, No. LXXXVIII, 2nd Series.

The above refers to the heavy cement, which weighed in England 118 to 120 lbs. to the bushel.

When lighter cements were used, the allowance was proportionately increased.

Full details of the process and cost will be found in No. CXXXIV of the Roorkee Professional Papers on Indian Engineering (2nd Series) for November 1874.

Artificial Hydraulic Lime.—Large quantities of artificial hydraulic lime have been successfully used on the Karáchi Harbour Works and on irrigation works in Sind.

In the manufacture 5½ parts by measure of ordinary slaked lime is mixed intimately (with the help of fresh water) with 1 part of clay.

The mixture is made into balls which, when thoroughly dried in the sun, are burned in a kiln. One part of this lime takes two of sand for superstructure work, and 3 for mortar in concrete, and footings.

Full description and details of the process and cost will be found in No. CXLVI of the Roorkee Professional Papers on Indian Engineering, 1st Series, for May 1867; also in the Roorkee Manual of "Limes, Mortars, and Cements", pages 21 and 26 (4th edition).

Portland Cement*.—The strength of cement decreases rapidly with the proportion of sand mixed with it. From experiments it was found that bars 1½ inches square of cement 112 lbs. to the bushel will break at the following weights in lbs:—

Gauged after	Neat cement.	1 sand 1 cement.	2 sand 1 cement.	3 sand 1 cement.	4 sand 1 cement.	5 sand 1 cement.
1 month.	680	309	123	58	32	21
3 months	878	367	254	135	109	88
6 „	979	547	425	232	157	95
12 „	1,076	700	458	320	221	122

Setting in water.—Cement increases in strength by setting in water.

	Average strength.		At end of 12 months.
In water	100	...	1,099
Out of water in-doors.	81	...	827
Out of water exposed.	77	...	720

Weight.—Cement increases in strength according to its weight.

Weight per bushel.	Tensile strain on 2·25 square inches.
106 lbs.	472
110 „	708
120 „	732
130 „	914

From which it would appear that an increase in weight of 24 lbs. to the bushel nearly doubles the tensile breaking weight of the cement.

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* From "The Manufacture of Portland Cement, by H. Reid, 1868."

Salt Water.—Cement appears to gain strength if mixed with salt water instead of fresh.

Cement 121 lbs. to the bushel.

After		Fresh water.		Salt water.
7 days	...	922 lbs.	...	943 lbs.
1 month	...	1,123 „	...	1,203 „
2 months	...	1,175 „	...	1,341 „
4 „	...	1,320 „	...	1,464 „
5 „	...	1,327 „	...	1,353 „

Compression.—Some experiments on compression of P. C. Bricks 9″×4′ 25″×2·75″=106·18 c. in. The surface subjected to pressure being 9″×4·25″=38·25 square inches, gave the following results:—

	3 months.		6 months.		9 months.
Neat P. C.	65 tons	...	92	...	102
1 cement 1 sand.	43 „	...	59	...	78
1 „ 2 „	34 „	...	47	...	62
1 „ 3 „	24 „	...	37	...	41
1 „ 4 „	23 „	...	31	...	38
1 „ 5 „	16 „	...	26	...	29

Cement.—The quay walls at Dublin were built of concrete 1 P. C. to 10 Liffy gravel, and stood after three months a crushing power of 16 tons per square foot.

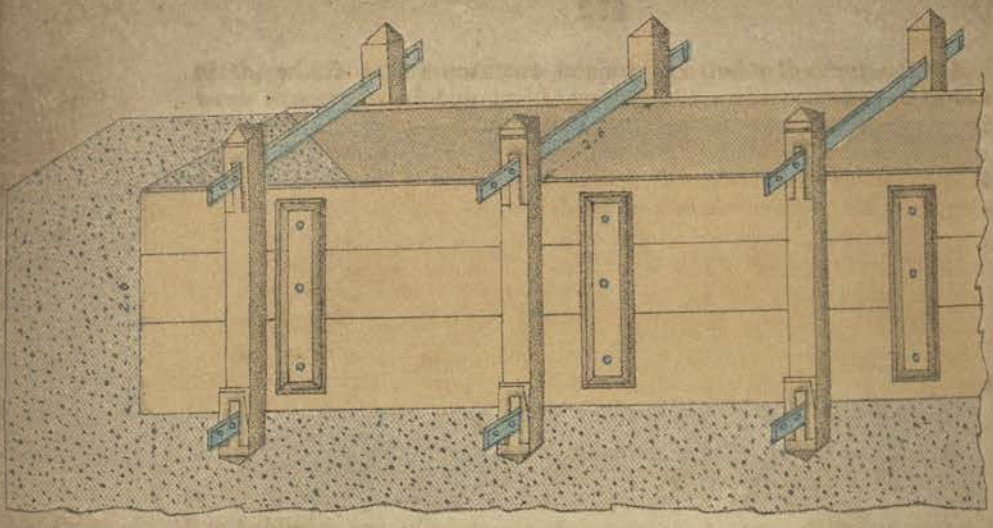
Sand.—Sand to be the most useful in a cement mortar should have porosity enough to fully absorb the moisture from the cement.

Paving.—Portland Cement in combination with chippings from Bath stone was tried some years ago, and paving slabs thus made are stated to have stood the traffic on the footpath of King William Street in the City for 14 years. The best cement, weighing 140 lb. to the bushel, was used mixed with the smallest possible quantity of water poured through the fine rose of a water-pot. The mixture of cement and chippings was shovelled into cast-iron moulds, bolted firmly together and materials rammed with iron rammers.

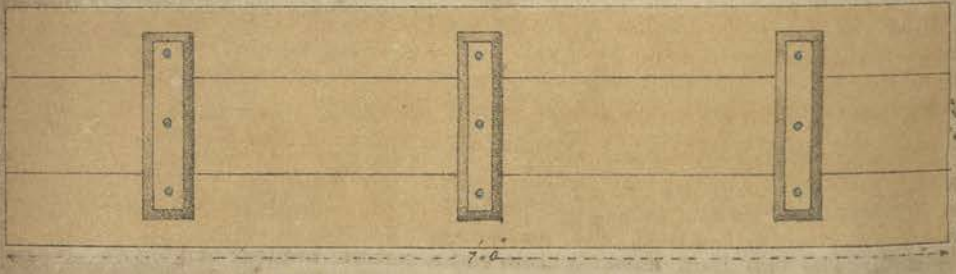
Portland Cement Skin over Concrete.—Useful for floors of all sorts. Very durable and much cheaper than paving. It can be made rough or smooth, even finely polished if necessary. Lay ordinary concrete, but with small sized metal or gravel, in the usual way to ½″ under required level, only being *very* careful to thoroughly consolidate by ramming. Let some time, say one month, elapse before laying on the cement skin, so that the concrete may have taken its final set before it is covered, otherwise it may cause cracks in the skin; then clean and scrape away all superfluous mortar and wet the surface; cement and clean sand to be mixed in equal proportions and floated on rapidly, average ½″ thickness is ample; water to be sparingly used in mixing, excess of it to be avoided. Keep covered with wet grass for ten days.

Wrought-iron.—If wrought-iron is roughed, it will form a perfect connection with Portland Cement coating.

Pise Box

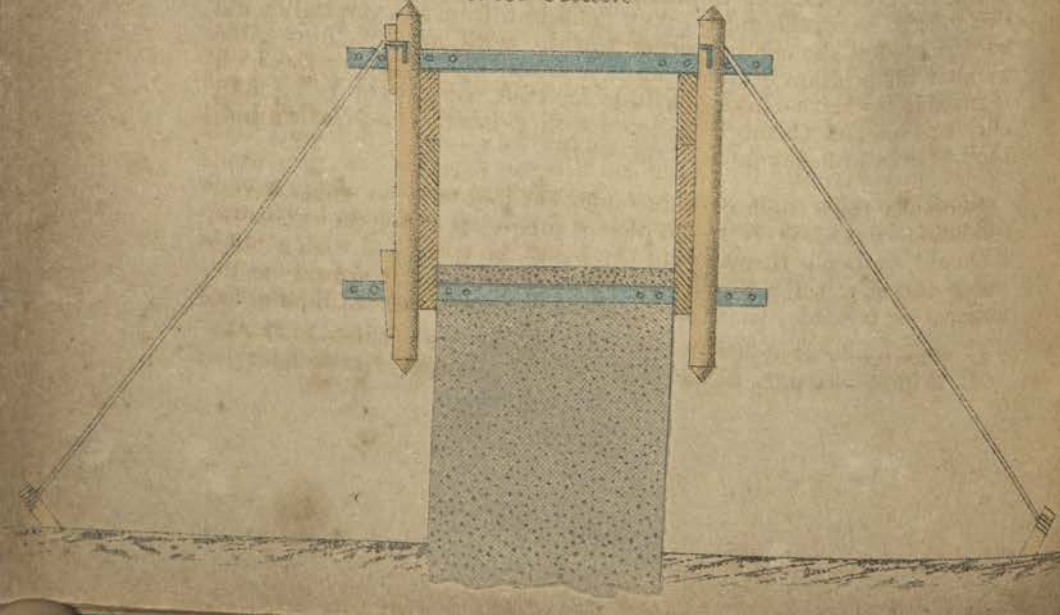


Side Elevation



Side Elevation of Pise Box

Cross Section



Affinity for water.—Good cement requires but little water to make good mortar. For 100 volumes of cement 44 volumes of water are generally added. If mixture requires more, heat will be developed, showing that the cement contains free or caustic lime. If less, it is a sign that it has been over-burnt, is too old, or is already charged with water or carbonic acid.

Professor J. Manger says good cement mortars require—

Cement.		Sand.		Water.		Mortar.
1	to	0	require	·44	and yield	·91
1	„	1	„	·66	„	1·83
1	„	2	„	·88	„	2·87
1	„	3	„	1·20	„	3·80
1	„	4	„	1·65	„	5·01

Bricks.—An excellent flooring brick or tile can be made from ground clinkers, vitrified bricks, and such materials mixed with a portion of good cement. The clinkers, &c., are roughly ground, and when well mixed with the cement, the materials are moulded and left to set. Bricks of this kind are very hard and heavy and wear remarkbly well under heavy traffic.

Pisé Work.—The following is a description of the Pisé work executed at Etah Jail during 1867-68.* From the accompanying sketch (see Plate XX) of the boxes used, it will be seen that the method adopted is equally applicable for concrete work.

The boxes in which the Pisé work was executed consisted of 2 wooden frames 10′ long and 2½′ broad, made of planks nailed on to stout battens. They are held together by 4 pairs of posts 3″ × 3″ which are connected above and below with tie bars of flat iron 1½″ × ¼″. The two bars have at each end a certain number of ½″ holes punched in them to receive pins for preventing the posts from slipping off. By changing the pins walls of any dimensions can be obtained. Wedges of hard wood with longitudinal slots are introduced between the posts and the pins to adjust the breadth of the boxes to the standard gauge. After the boxes are fixed and adjusted they are secured in position by ropes passing over them and tied to stakes on each side. Any deflection from the vertical should be corrected at the commencement of the work, as it is impossible to alter the position of a box after it is half full. Any earth which is suitable for brick-making will do for Pisé work. On being dug out it is passed through a screen with ½″ meshes and thrown into the boxes in even layers of 6″ in depth.

Generally fresh earth contains sufficient moisture to ensure consolidation, but if it is found that it jumps up under the rammers, it should, on being thrown into the boxes, be sprinkled with a little water out of a tin can with a rose. The watering should be as uniform as possible, as if it is applied unequally, it will liquify the

* From Standard Specifications for Oudh.

earth, which will commence oozing out under the rammers. Pisé work executed with too much water is worse than if done with dry earth, as, on account of the elasticity of the wet earth, the effect of the ramming is deadened and the earth remains unconsolidated. The men should be prohibited from keeping time in ramming, as it causes vibration, which is injurious to the stability of the wall.

On working over an old course it is as well to set the lower tie bars about 4 inches into the same to give the boxes a firm hold on the old work. Thereby the joints become imperceptible, and the upper edge of the lower course is prevented from chipping off.

The implements used are 3 rammers of different shapes. The earth is first beaten down with a V-shaped rammer, and then surfaced with a flat-bottomed one. The sides are consolidated with a spade-shaped one.

To overcome the difficulty experienced in extracting the lower tie bars, holes were made in the latter 3″ apart throughout their whole length. A pin was inserted against which a crowbar with a long slot, and well bent at the end, was made to work. An equal pressure could thereby be exerted against the tie bars, which can thus be extracted with facility.

If the inside of the frames are well smoothed, and they are continually kept in gauge, the Pisé walling will present a very substantial and uniform appearance when completed.

The cost of 100 cubic feet of Pisé work on a wall 14′ high and 2½′ thick would probably be as follows, the average lead being about 800′ :—

Digging	1 coolie ...	...	As. 4
Carrying earth... ...	4 women ...	...	8
Ramming, including putting up and taking down boxes.	6 coolies ...	...	1-8
Screening, breaking up earth.	1 coolie ...	...	4
Watering	1 woman ...	...	2
Cost of box, 1 box being able to turn out 5,000 cubic feet		...	8
Baskets, ropes, repairs, &c....	... ...	...	4
		Rs.	3-6

It requires only one day to fix and fill one Pisé box (with half the labour given above, each case containing 50 cubic feet). The work was generally conducted in the following manner. In the morning the boxes were taken down, and again put up and filled during the day; they were left during the night, so that the earth might detach itself from the sides. It is not advisable to allow a course to dry thoroughly, as the upper one will not bind well into it, but probably show a crack. If the earth is well rammed, and only the proper quantity of moisture admitted, a second course can be commenced at once.

The rate for concrete work would probably be Rs. 2 per 100 cubic feet in addition to the cost of the concrete.

P. C. Concrete Arch.—An experimental arch of 75′ span 7½′ rise made entirely of concrete, has lately been constructed over the

Metropolitan Railway, and has proved quite successful. The concrete was 3½′ thick at the crown of the arch increasing towards the haunches, which abut on concrete skew backs. The concrete was composed of 1 part of Portland Cement to 6 parts of gravel carefully laid in mass upon close boarding set upon the centring and enclosed at the sides.

Major James Browne, R.E., recomends that all arches should be elliptical and not segmental; as in a segmental arch the stones work down from the ramming into the corner formed between the arch and the abutting block, and the mortar of the concrete works up.

Concrete Walls.—At Rawul Pindee Jail walls 16′ high 2′ thick have been built entirely of concrete composed of

12 cubic feet lime,
20 „ soorkee,
100 „ gravel,

carried up in 6″ layers and rammed. The flat arches over doors and verandah pillars were made of the same material.

Beton Pise′.—Mr. Coiguet has, as the result of a series of experiments, given recipes for making 2 kinds of concrete suitable for house building, which he distinguishes by the epithets of Economic Concrete and Hard and Solid Concrete. The first is composed of—

Sand, gravel, and pebbles	...	...	...	7 parts.
Argillaceous earth	...	...	...	3 „
Quick-lime	...	...	...	1 „

This concrete, he says, properly beaten up and mixed, has given walls nearly as hard as the common soft rubble masonry used in Paris. In price it competes with ordinary Pisé, over which, however, it has the advantage of being able to resist moisture. The hard concrete is composed of—

Sand, gravel, and pebbles	...	...	...	8 parts.
Common earth burnt and powdered		...	...	1 „
Cinders powdered	...	...	...	1 „
Unslaked hydraulic lime	...	...	...	1½ „

The materials to be perfectly beaten up together. Their mixture gives a concrete which sets almost immediately, and becomes in a few days extremely hard and solid, which property may be still further increased by the addition of a small quantity, say, one part of cement.

Extract from the Report on the Paris Exhibition of 1855.

A house three stories in height 65′×45′ standing on a terrace having a perpendicular retaining wall has been actually constructed with every part, without exception, of this concrete (béton dur). * * * The use of plaster in the interior is also avoided, as the concrete makes a surface sufficiently fine for papering.

Aqueduct of La Vanne, 135 miles long, constructed towards the close of the late French Empire to bring into Paris the water of La Vanne River.—The greatest difficulties met with were in the forest

of Fontainebleau, a distance of 37 miles, entirely destitute of good building material, and cut up by immense hills of almost impassable quicksand.

To this section the Beton Coiguet construction (afterwards continued through nearly the whole work) was begun.

The Fontainebleau section is composed of a series of arches, some of them as much as 50′ high, 8 or 10 bridges of large span (75′ to to 90′) are also included, all made of solid masses of (Beton Coiguet).

The composition of this concrete was—

For foundation and gravel walls, sand and gravel in equal parts 5; hydraulic lime 1, Portland Cement ¼ parts. For pillars, abutments, &c., sand, and in some cases gravel, 4, hydraulic lime 1. The other portions were made from sand 4, hydraulic lime 1, Portland Cement ¼ to ½.—*Scientific American*, 25th March 1876.

New pavement in Newgate Street.—85 per cent. ground granite, 15 per cent. bitumen, laid in a heated semifluid condition two inches thick upon 9′ foundation of Portland Cement Concrete.—*Scientific American*, October 7th, 1876.

Hydraulic Cement.—The following is stated to be an excellent one:—

Eight parts by measure of slaked (Kunkur) lime, 1 part black soil, intimately mixed, made into balls 3″ or 4″ in diameter, burnt and powdered. This mixture will take 6 or 7 of sand to 1 of cement. Tensile strength of some roughly made cement pure of this sort 80 lbs. to the square inch.

Asphalt.—How to fuse and prepare.

A large cauldron or iron pot having been provided and a fire lighted under it, put into it from 100 to 250 lbs. (according to size of pot) of asphalt broken into pieces of not more than ½ lb. each; mix the asphalt with a stirrer in such a way that the pieces at the bottom are constantly brought from the bottom to the surface.

When the whole quantity is thoroughly fused, sand or grit is to be added in the proportion of 2 parts sand to 1 of asphalt; the sand should be added gently and constantly stirred for the purpose of keeping the contents of the boiler properly mixed, and to prevent their becoming burnt and clinkered to the sides and bottom of the boiler. When fit for use the compost will emit jets of light smoke and freely drop from the stirrer; it should then be raised as rapidly as possible to prevent its becoming overburnt.

Directions for applying the compost.—Having provided gauges of the required thickness, place one with weights bearing on its outer edge, parallel to one of the sides of the floor to be covered, and at a distance of about 3 feet; this will form the width of the several layers of pavement or flooring to be covered. In this space the spreader kneels, and as soon as the compost is poured down, it is to be spread with a trowel. To facilitate this work, an ordinary floating rule or piece of hard, straight wood, about 3½″ in length,

may be used to level the compost to the thickness of the gauge; and any unevenness in the surface may be easily corrected by the trowel or hand-float.

Before the compost becomes hard a small quantity of very fine sand should be shifted over it, and well rubbed into it with the hand-float.

The contents of each cauldron should be sufficient to cover one layer, and it should be poured all along the space to be covered. If a considerable quantity remain, the gauge may be widened; but if only a small quantity, it should be put back into the cauldron and boiled over again with the next supply.

When the first layer is finished the adjoining space should be covered at a later period. (The object of leaving alternate vacant spaces is that the workmen employed in rubbing may not have occasion to kneel on any part of the asphalt until cool, nor should the gauge be removed till the asphalt has become set).

Adjoining this vacant space, two gauges are then to be laid down at the same distance apart and weighted as before mentioned. The space between the gauges must then be covered with the compost and rubbed in the manner before described. In about ½ an hour the compost will have become quite firm, when the gauges should be carefully removed. The sides of gauges should be oiled to prevent their sticking.

For the flooring of rooms or tops of arches, a layer ¾th of an inch thick will be sufficient; but for pavements, where there is much foot traffic, the thickness should be increased from an inch to an inch and a half.

Laying Mosaic Floors.—Mix 1 part powdered brick with slaked lime and spread it to a depth of 2 to 2½ inches over the masonry bedding; bring the surface to a fine level. This should be done in small pieces at a time, to prevent their drying instantaneonsly. On this lay a thin layer of cement prepared with two parts of sifted slaked lime, one of powdered marble, and one of Puzzolana, mixed to a consistency of paste; it should not be thicker than ⅛th of an inch spread over the surface; this after a lapse of 4 hours may be considered ready to receive marble pieces. If it is to form a pattern with designs, define the outlines into their respective colours by hammering in the marble pieces, taking their best sides to form the outlines, the size of pieces to be 1½ inches cube, or less, according to the size of the diagram; after which fill in the spaces with pieces of their respective colours according to the design. When this is done, a stone roller about 12 inches diameter, and 1′ 6″ to 1′ 9″ long, is passed over the surface gently, water being sprinkled every now and then; this carefully done for about 4 hours will bring all the pieces of marble to an even surface, and will work up the cement below between the interstices. The next process is to allow the surface so prepared to dry for 24 hours, after which rub the same with a piece of pumice stone 9″ × 10″ × 3″ fixed

to a wooden handle 6 feet long; this polishes the surface, as well as works up the conical pieces of marble to an even and smooth plane. This will have to be done for at least two weeks. The last process is to allow the floor to dry for some weeks before its use. If extra polish is required, rub the surface with tripoli powder and powdered blue vitriol or sulphate of copper with a few drops of vinegar or dilute acetic acid; this will produce a fine polish.

To utilise broken Tiles in Pattern Floors.—Bring the concrete floor to a level $\frac{3}{4}$ inch lower than the true level of the floor when complete; on this when dry lay a thin layer of Portland Cement or neroo chunam, say $\frac{1}{10}$ inch deep, and arrange the pieces of tiles, taking a small portion at a time, in order to prevent too rapid drying, of such design as the different colours may suit to form a pattern either mixed or of different coloured strips. When laid, sprinkle dry cement or neroo over the surface, passing the roller as described in the Italian floors. An hour or two manipulation will set closely all the pieces compactly and form a nice surface. Greater care will have to be bestowed in arranging or laying the pieces of tiles than in laying the pieces of marble. When the floor is quite dry, which will take about three weeks, wash it with water, rubbing the surface with pumice stone; a slight rubbing with oil will bring out all the rich colour of tiling.

Trellis Work in Chunam.—The place where the trellis work is to be made is first built up with a thin wall to serve as a temporary backing. The lime (from blue limestone) is then slaked and allowed to remain so for half an hour. When it is sieved, $\frac{1}{3}$ of fine soorkee is added and whole well mixed, care being taken not to add too much water. A clean even space is then prepared on the ground, and the mortar spread over it in the layers 2″ or 3″ thick, and as soon as it is sufficiently hard it is divided by the trowel into bricks about 6″ × 4″.

A wall of these bricks is then built up in front of the backing above mentioned, and a small quantity of the finest mortar used to cement them together and the wall surface is carefully levelled by floats and straight edges. It is allowed about a day to dry.

The next day the pattern is drawn on it and the hollow spaces cut out with fine pointed trowels or chisels, water being sprinkled on the work as it proceeds to keep the place moist. The pattern is cut right through to the backing, which is removed as soon as the trellis is dry enough to stand by itself. It can be polished to present the appearance of marble if required.

Wood Work.

The principal woods in use in this Presidency are as follows:—

Unjun.—Hardwickia Binata.—A large tree growing in the Godávari forests and elsewhere, very tall and straight. The wood is dark coloured, and heavy, and of an excellent quality for posts.

Babul.—Acacia Arabica.—The tree seldom attains a greater height than 30 to 35 feet, or a greater thickness than 2 feet. The wood is of a light red colour, close grained, hard and tough, and, though rather heavy, is preferred for many purposes on account of its durability.

Blackwood.—Dalbergia Latifolia.—This timber has white wood surrounding the body and heart, which last is of a blackish brown colour; the ring in this case does not exceed 1½″ in breadth. The dark wood is exceedingly heavy, being exactly the same weight as water. It is stated to be as strong as teak, and if all sap wood is cleared off as good as teak for work not exposed to weather. Stands exposure well, is sound under water; but when alternately wet or dry decays rapidly; splits considerably when exposed to the sun and blows of pile driver.

Mutti.—Terminalia Tormentosa.—Wood of a reddish brown colour, hard, heavy, durable under water, rather coarse in fibre, and difficult to work. In seasoning the grain is apt to open. Requires 12 to 15 months to season; is not readily touched by white ants.

Teak.—Tectona Grandis.—Too well known to need description. The best teak in the Bombay market comes from Moulmein. Calicut teak is now scarcely obtainable.

Pine.—American, obtainable in the Bombay market.

Cedar.—Singapore, a reddish wood, not unlike benteak in appearance; very light; obtainable in Bombay market about the same price as American pine.

Australian Gum.—It is a pity that more of this class of wood is not imported, as its properties of lasting under water are stated to be far superior to those of any Indian woods, teak not excepted.

Jarrak, or *Australian Mahogany,* is also said to be an excellent wood.

Honay.—Pterocarpus Marsupium.—A pretty wood and easily worked; used in the interior of houses; not durable when exposed.

Jamba.—Inga Xylocarpa.—This valuable timber tree known as the *Iron wood* of Arracan is found throughout Southern India and Burmah, furnishing a wood of very superior quality, heavy, hard, close-grained, and durable, and of a very dark red colour; it is, however, not easily worked and resists nails. It is extensively used for bridge building, posts, piles, &c., and is a good wood for sleepers, lasting (when judiciously selected, and thoroughly seasoned) for six years.

Arjun.—Terminalia Arjuna.—A tree widely diffused, often found in company with teak, and growing to a very large size. It furnishes a dark brown, heavy, very strong wood, suitable for masts and spars, beams and rafters.

Bakool.—Mimusops Hexandra.—This tree grows in South India and Gujarát, and furnishes wood, heavy, close and even-grained, of a

pink colour, standing a good polish: used for cabinet making purposes and ordinary house building.

Honagi.—Nauclea Cordifolia.—This is a very large tree, with a soft, close, even-grained wood, but light and more easily worked, and very susceptible to alternations of temperature. It is esteemed as an ornamental wood for cabinet purposes.

Hurda.—Terminalia Chebula.—A beautiful and lofty tree with horizontal branches, growing in tiers; planted in gardens and avenues. The wood is used in Southern India for common house building, but it is light and coarse-grained, possessing little strength, and liable to warp. In Burmah it is used for yokes and canoes. The fruit and galls are used by dyers.

Jack.—Artocarpus Integrifolia.—The common 'jack fruit' tree is of rapid growth, and reaches a very large size. It is found all over India, and is esteemed both for its fruit and timber, and with its abandant dark foliage and numerous pendent fruit is a handsome object. The wood when dry is brittle, and has a coarse and crooked grain. It is, however, suitable for some kinds of house carpentry and joinery; tables, musical instruments, cabinate and marquetry work, &c. The wood when first cut is yellow, afterwards changing to various shades of brown.

Kalamb.—Nauclea Parviflora.—A large fine timber tree; with a wood of fine grain easily worked, used for flooring planks, packing boxes and cabinet purposes; it is much used by the wood carvers of Saharunpore.

Mango.—Mangifera Indica.—The *Mango* is generally diffused over all the warmer parts of Asia, and is much esteemed for its fruit. Its wood, however, is of inferior quality, coarse and open grained, of a deep gray colour, decaying if exposed to wet, and greedily eaten by white ants. It is, however, largely used, being plentiful and cheap, for common doors and door-posts, boards and furniture, and also for firewood. It should never be used for *beams*, as it is liable to snap off short.

Sirris.—Acacia Speciosa.—The '*Sirris*' is a common tree throughout India, and with its rapid growth, its large head of handsome foliage and sweet scented flowers, is a good avenue tree. It grows to 40 or 50 feet in height and 5 to 6 feet in girth: the wood is said by some writers to be hard, strong, and durable, never warping or cracking, and to be used by the natives of South India for naves of wheels, pestles and mortars, and for many other purposes: but in Northern India it is held to be brittle, and fit only for such purposes as box planks and for firewood.

Tamarind.—Tamarindus Indica.—The *Tamarind* is a very handsome tree for avenues, gardens, &c., of very slow growth, but attaining a great size, and much valued for its fruit. The heart wood is very hard, close grained, dark red, very hard to be worked; used for turnery, also for oil presses and sugar crushers, mallets, and plane handles; it is a very good brick burning fuel.

LIST OF THE PRINCIPAL TREES IN THE BOMBAY PRESIDENCY.

Local Names.	Botanical Names.	Weight in lbs. of a C.F. of seasoned wood "W."	Co-efficient of Deflection elasticty in lbs. per Square Inch "Ed." l.	Intensity of direct Ultimate stress or Tenacity in lbs. per Square Inch "ft." (Tensile).	Intensity of Dead Breaking weight in lbs. per Square Inch "p." (Cross strain.)
Unjun	Hardwickia Binata	85	4579	12016	942
Babul	Acacia Arabica	54	4111	16815	876
Blackwood ..	Dalbergia Latifolia	50	4053	20283	912
Mutti	Terminalia Tormentosa	60	4043	22351	860
Teak	Tectona Grandis	42	3978	14498	683
Honay	Pterocarpus Marsupium	56	4132	19943	868
Jamba	Inga Xylocarpa	58	4283	16657	836
Arjun	Terminalia Arjuna..	54	4094	16288	820
Bakool	Mimusops Hexandra	70	3948	19036	944
Honagi	Nauclea Cordifolia..	42	3052	10431	506
Hurda	Terminalia Chebula	32	3108	7563	470
Jack	Artocarpus Integrifolia	44	4030	16420	788
Kalamb.. ..	Nauclea Parviflora....	42	....	....	400
Mango	Mangifera Indica	42	3120	7702	560
Sirris	Acacia Speciosa	55	3502	....	532
Tamarind ..	Tamarindus Indica	79	2803	20623	816

Teak Trusses.

General Waddington considered iron straps for the feet of principals into the king or queen posts unnecessary; but, if used, they should be attached by one bolt only.

In the queen post trusses from 24 feet span upwards, two small principals about 4′ 6″ long and $2\frac{3}{4}$″ by 3″ are allowed (in the "contents of truss") to support the ridge-plate.

In trusses of 42 feet span and upwards, two cross braces, 4″ × $4\frac{1}{2}$″, are also allowed between the queen posts.

The trusses are calculated for a double-tiled roof. Trusses 10 feet central distances, slope 30° (nearly 2-7ths), rafters 1′ 3″ central distance teak battens 2″ × $\frac{3}{8}$″ at 4″ central distance, double bamboo matting, tiles 10″ × $3\frac{1}{4}$″ diameter.

Eaves single tiled, (lower in lime,) projecting 2′ 6″ horizontal, ridge lime, walls two feet thick, ceiling plaster.

Struts parallel to opposite principal, and divide that on which they impinge equally.

Width of principals, king or queen post and straining beam, equal to that of tie beam.

Materials required for 100 square feet of double tiled roof—

2,200 tiles 10″ × $3\frac{1}{4}$″.
100 square feet double mat.
1′ 6″ 9‴ 0⁗ cubic feet teak battens.
240 nails $1\frac{3}{4}$″ long, weight about 2 lbs. $6\frac{1}{2}$ oz.

For single tiled roof, 1,100 tiles, the rest the same as above.

10 running feet of eaves board $10'' \times 4' \times \frac{3}{4}''$ is 0′ 2″ 6‴ 0⁗ cubic feet.

Rafters 3″ diameter are nailed to ridge pole, wall or pole or post plate, and to each purlin by 6″ spikes, weight about 2 oz. each.

To find length of rafter, multiply breadth from eave to eave by ·577. To find number multiply length of building eave to eave by ·8. If the rafters procurable are not a multiple of the distance between the purlins there will be waste.

To find length of hip-rafter, multiply breadth from eave to eave by ·763.

Each truss requires one nine-inch spike for ridge, one through each purlin, and two through purlin block, which should be $1' \times 5'' \times 3\frac{1}{2}''$. Each spike weighs about 4 oz., the purlin block comes out of wastage.

25 per cent. is usually allowed on the net contents for wastage in converting timber.

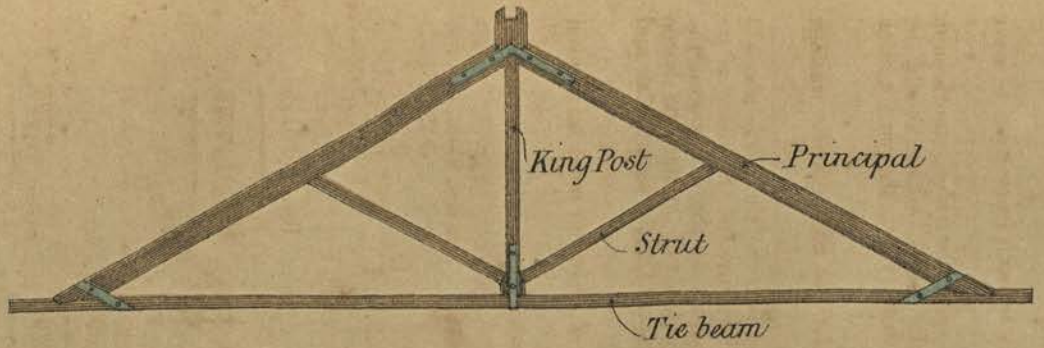
The toe of the principal should be let into the tie beam about $\frac{1}{2}$ an inch, the tenon should be let into the centre of thickness of tie beam, and both should be cut off square to the direction of the principal. In using this table (see Table XIV) it must be borne in mind that it is calculated for the best Calicut teak timber and the best workmanship.

If either of these are inferior, extra scantling must be allowed for.

The following shows the weight of 1 square foot of double-tiled roof:—

22 tiles $10'' \times 3\frac{1}{4}''$		= lbs.	27·5
Double bamboo mat			0·4375
Batten $3 \times 2'' \times \frac{3}{8}''$	=27 C. I.		0·7275
Rafter $\frac{4}{5} \times 3''$ diameter	=67·858 C. I.		1·8285
$2\frac{3}{5}$ Nails $1\frac{3}{4}''$ (100 to the lb.)			0·0240
		lbs.	30·5175
1 square foot single tiled roof. *Deduct* weight of 11 tiles	...	lbs.	16·7675
Chunam eaves, exclusive of tiles, ten feet running	...	lbs.	90
Eaves board $10' \times 4'' \times \frac{3}{4}''$ =360 in.			
Deduct batten displaced. 90			
270			7·275
Total 10 running feet eaves	...	lbs.	97·275

King post Truss



Queen post Truss

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Plate XXI.

Plate XXII.

Scarfing & Joints of Principals with Tiebeam.

Fig: I.

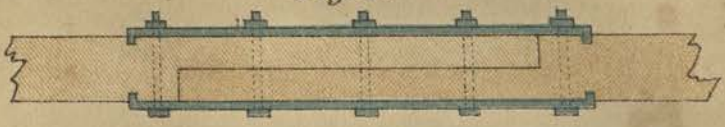


Fig: II.

Fig. III.

Fig. IV.

Fig: V.

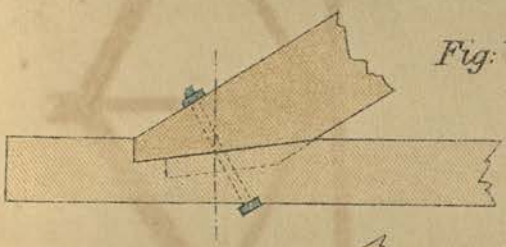


Fig: VI.

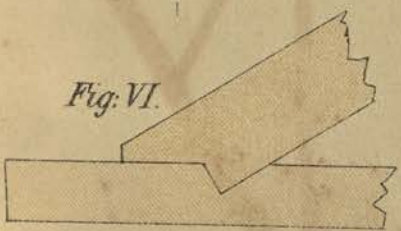


Fig: VIII

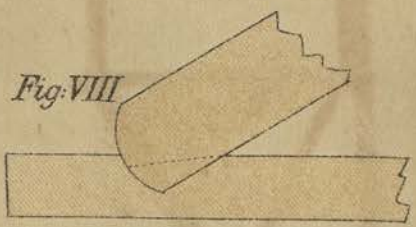


Fig: VII

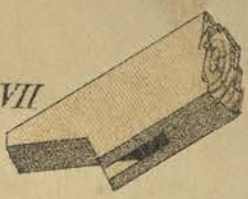
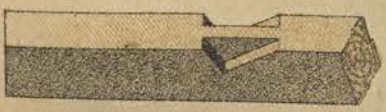
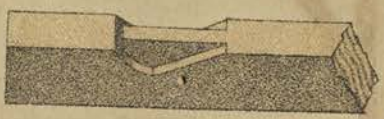


Fig: IX.





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Joints of Principals, Struts &c: with King & Queen posts.

Fig. I.

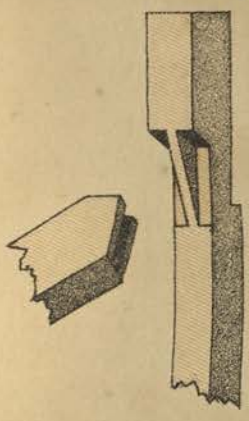


Fig. III.

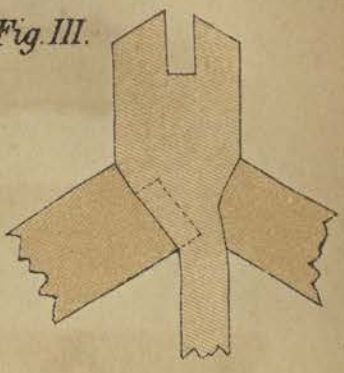


Fig. II.

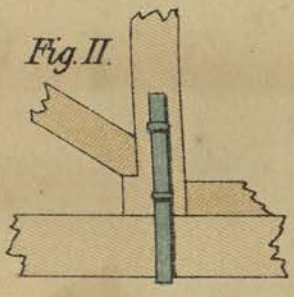


Fig. IV.

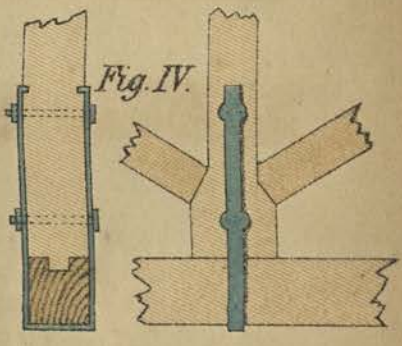


Fig. V.

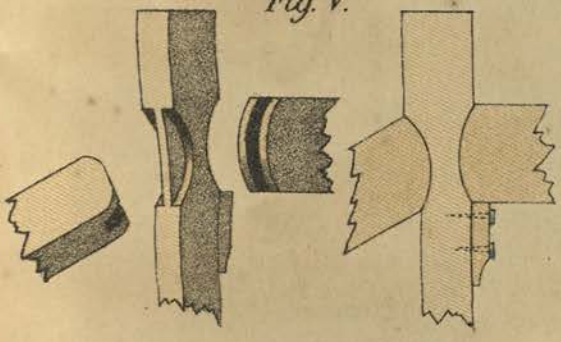


Fig. VII.

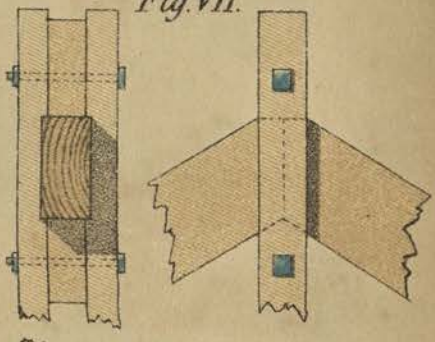


Fig. VI.

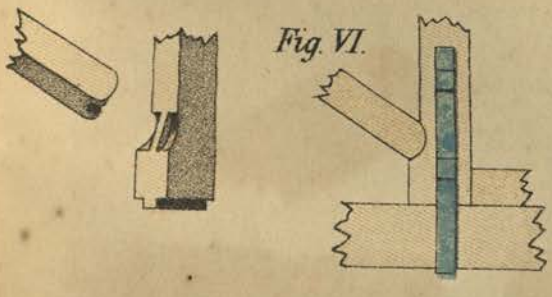
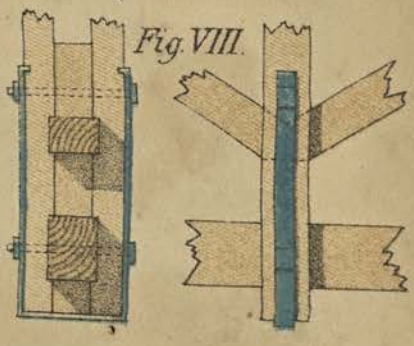


Fig. VIII.



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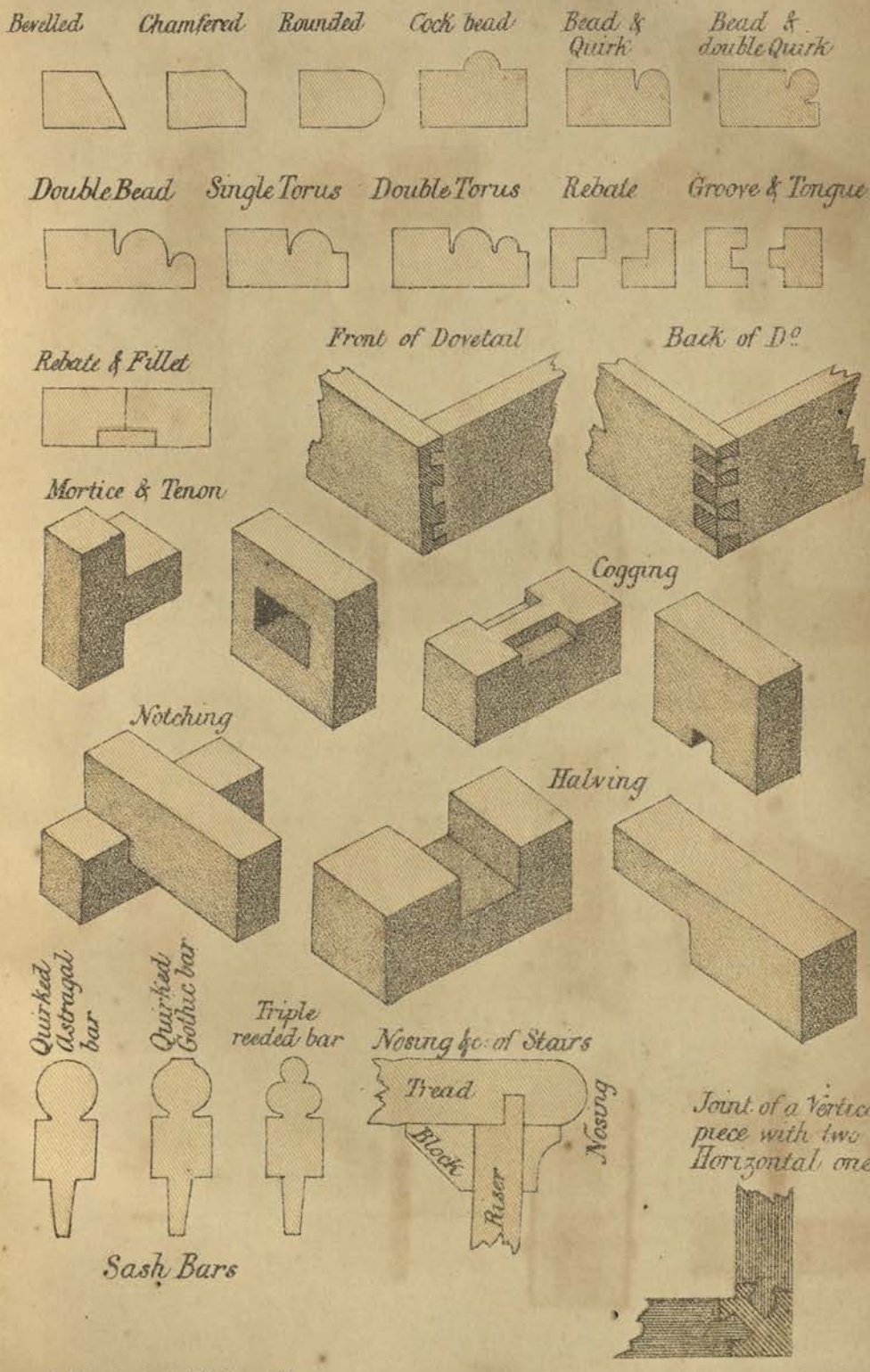
Joinery



Govt Photozincographic Office, Poona, 1863

Ridge per foot	lbs. 28	
Plaster, Ceiling, per square foot.		
1 Teak Joist, $12'' \times 1\frac{1}{2}'' \times 3\frac{1}{2}''$	=63	
Battens nailed to tie beam $\frac{1}{5}'' \times 1\frac{1}{2}'' \times 2\frac{1}{2}''$	9	
12 ceiling battens $12'' \times \frac{3}{8}'' \times \frac{5}{8}''$	33·75	
Cubic Inch Timber 105·75	=lbs.	2·8495
$\frac{1}{5}$ Joist nail 6" (8 per lb.)	...	0·0250
$\frac{1}{5}$ Batten nail 3" (30 per lb.)...	...	0·0066
12 Ceiling nails (240 per lb.)	...	0·05
1 square foot of plaster	...	11·3750
	lbs.	14·3061

For dimensions of trusses see Tables VIII to XIII.

Verandah Posts.—It is not an uncommon thing in this country to see verandah posts forced outwards by the thrust of the roof, owing to the tops of the rafters not being securely fastened to wall plates, but simply laid in the wall. A very good illustration of this can be given by laying a stick hooked at one end on the black bar of a chair, and letting the lower end rest on brick standing on its end. If the stick is hooked to the back of a chair and a pressure applied in the centre, the brick will fall inwards; but if the stick is not hooked, when pressure is applied the brick falls outwards.

Note.—In practice it is generally found sufficient to use the trusses for the *next larger* span; thus, for 20′ spans use trusses in table for 22′ spans.

Iron Trusses.

The following table, taken from the Engineers' Pocket Book for 1863, gives the dimensions of the parts of some iron roofs of the simplest form as shown in Plates XXV and XXVI:—

Span A.	Rise in centre B.	Rise of Tie-rod C.	Distance apart of King and Queen bolts D.	No. of pairs of Queen-bolts.	No. of pairs of Struts.	Dimensions of rafters *pp*.				Dimensions of strut *ss*.				Diameters of				
						Width of Top-table *w*.	Thickness of Top-table *t*.	Total depth *d*.	Thickness of Rib *p*.	Width of Top-table *w*.	Thickness of Top-table *t*.	Total depth *d*.	Thickness of Rib *p*.	Tie-rod *t*.	King-bolt *k*.	Queen-bolt *q*.	Queen-bolt 2nd pair *q*.	Queen-bolt 3rd pair *q*.
Ft.	Ft. In.	In.	Ft. In.			In.	In	In.	In.	In.	In.	In.	In.	In	In.	In.	In.	In.
20	4 0	6	5 0	1	1	2	1/4	2 1/4	1/4	1 1/2	1/4	1 1/2	1/4	3/4	1/4	1/4	..	..
25	5 0	7 1/2	6 3	1	1	2 1/2	1/4	3	1/4	1 1/2	1/4	2	1/4	1	1/4	1/4	..	..
30	6 0	9	5 0	1	2	2 1/2	1/4	3	1/4	1 1/2	1/4	2	1/4	1 1/8	1/4	1/4	1/4	..
35	7 0	10 1/2	5 10	1	2	2 3/4	1/4	3 1/2	1/4	2 1/4	1/4	2 1/2	1/4	1 1/8	1/4	1/4	1/4	..
40	8 0	12	6 8	1	2	3 1/4	1/4	4	1/4	2 3/4	1/4	3	1/4	1 1/4	1	1/4	1/4	..
45	9 0	13 1/2	5 7 1/2	2	3	3 1/4	1/4	4 1/2	1/4	2 3/4	1/4	3	1/4	1 1/4	1 1/8	1/4	1/4	1/4
50	10 0	15	6 3	2	3	3 1/2	1/4	4 1/2	1/4	2 3/4	1/4	3	1/4	1 1/4	1 1/4	1	1/4	1/4
55	11 0	16 1/2	6 10 1/2	2	3	4 1/2	1/4	1 1/2	1/4	2 3/4	1/4	3 1/2	1/4	1 3/8	1 1/4	1	1/4	1/4
60	12 0	18	7 6	2	3	5	1/4	1 3/4	1/4	3	1/4	3 3/4	1/4	1 1/2	1 3/8	1 1/8	1	1/4

The strength of the parts is calculated for principals placed 6 feet apart and covered with any of the ordinary materials. If the principals are more than 7 feet apart a little excess should be allowed in the dimensions of the rafters, &c. The outlines of the roofs are shown in Figs. 1 to 4. In all these roofs for spans from 20 to 50 feet the rafters and struts are of rolled T iron and tie-rods, king and queen bolts of round and rod iron. For spans from 50 to 60 feet the T iron rafter is deficient in lateral stiffness, and is therefore supplanted by rafters formed of 2 bars as shown in Fig. 6. These 2 bars are placed 1½ to 2 inches apart, and the space between them is filled with wood, the bars and intermediate wood being secured by rivets. If it is desired to avoid the use of wood, cast-iron studs or stretchers are fixed between the bars by bolts which pass through them and are squared with nuts.

Fig. 16 represents the mode of securing the tie-rod and rafter in a cast-iron shoe; a wrought-iron gib and key pass through the shoe, and the tie-rod and the rafters are fixed by a screwed bolt and nut. The other ends of the tie-rod are formed with eyes, and connected to 2 wrought-iron plates as shown at Fig. 12 by bolts and nuts; the same bolts also connect the struts of which the ribs are cut off and the ends of the top flange bent and punched for the purpose. The king bolt passes through a hole in the middle of each of these wrought-iron plates, and is screwed at the end and has a nut above and below. The plan of these wrought-iron plates also shows 2 holes at right angles with those for securing the tie-rods. These are for the purpose of securing in a similar manner longitudinal tie-rods where they are deemed necessary. At the points where the struts meet the tie-rods the latter are forged with eyes as shown in Fig. 14, and the queen-bolts, struts and tie-rods secured together as there shown. Figs. 9 and 10 represent the method of connecting the upper end of the struts with the queen-bolts and rafters. The end of the struts is bevelled off to range with the under side of the rafter, and riveted to two strips of plate-iron, one on each side of it. The end of the queen-bolt is forged with a jaw, Fig. 11, and holes formed in it through which, and also a corresponding hole in the rafter, a bolt passes and is secured by a nut. The heads of the rafters and the king-bolts are fixed in a cast-iron head, Figs. 7 and 8, formed with a central hole for the bolt and two lugs or ears on each side for receiving the ribs of the rafters secured by bolts and nuts. A wrought-iron key passes through the king-head and the king-bolt. The upper part of the king-head has 2 flanges each with two holes for receiving the ends of the T iron ridge bars, and on these a wooden ridge is fixed with lead or sheet iron capping.

Galvanized Iron Roof Covering.—For buildings no corrugated iron of less than 20 gauge should be used, 22 and 24 gauge being only suited for temporary sheds.

The following are the approximate weights per square for the different gauges :—

Iron Roofs and Details.

Fig. VII.

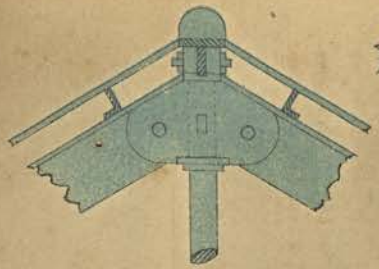
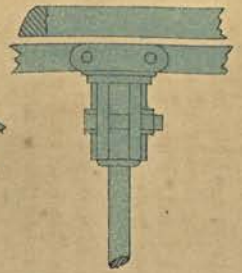
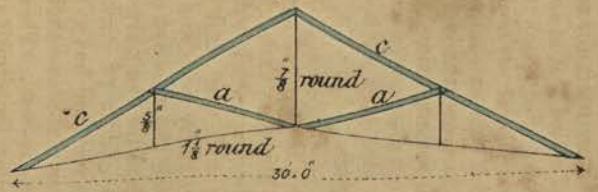


Fig. VIII.



Rafters c.c.

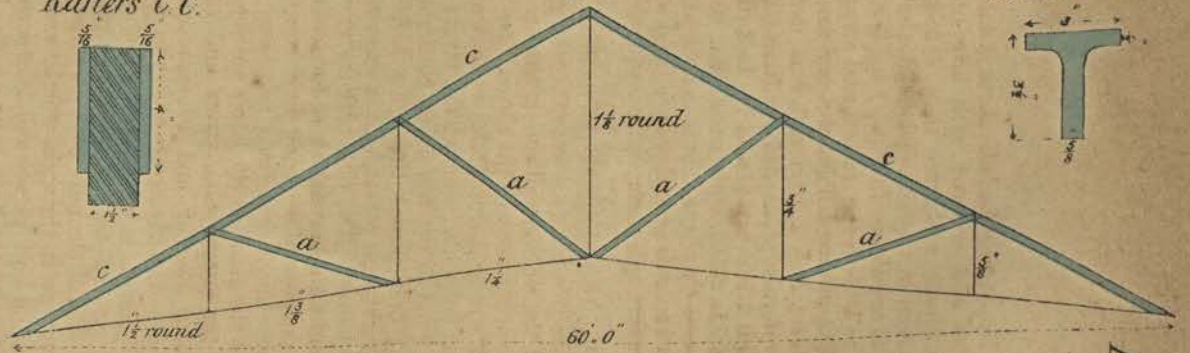
Fig. I.



Struts a.a.

Rafters c.c.

Fig. II.



Struts a.a.

Fig. XII.

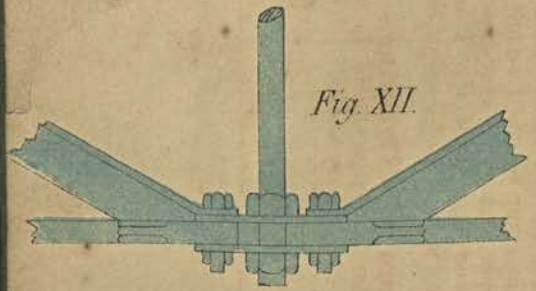


Fig. XIII.

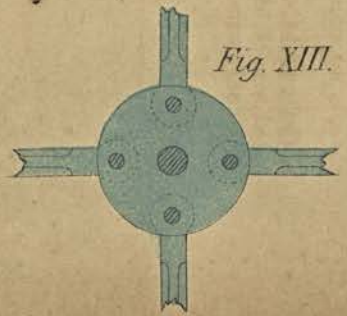


Plate XXV

Govt. Photozinco Office, Poona. 1883

Iron Roofs, and Details.

Fig: IX

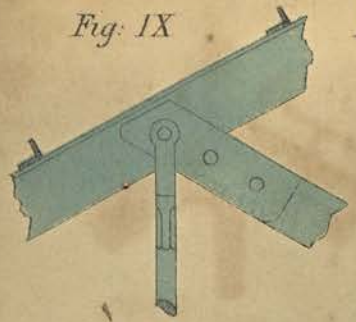


Fig: X

Fig: XI

Fig: XIV

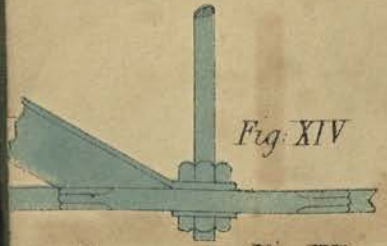


Fig: XV

Fig: XVII

Fig: XVI

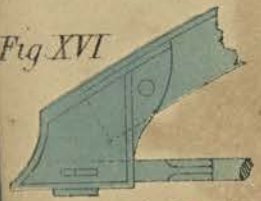
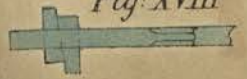
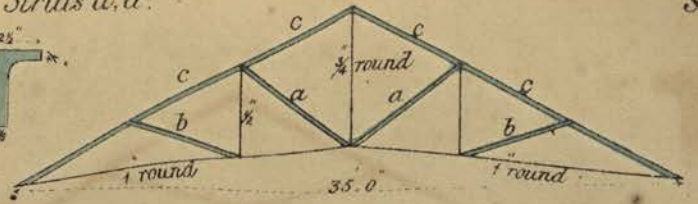


Fig: XVIII



Rafters c,c & Struts a,a.

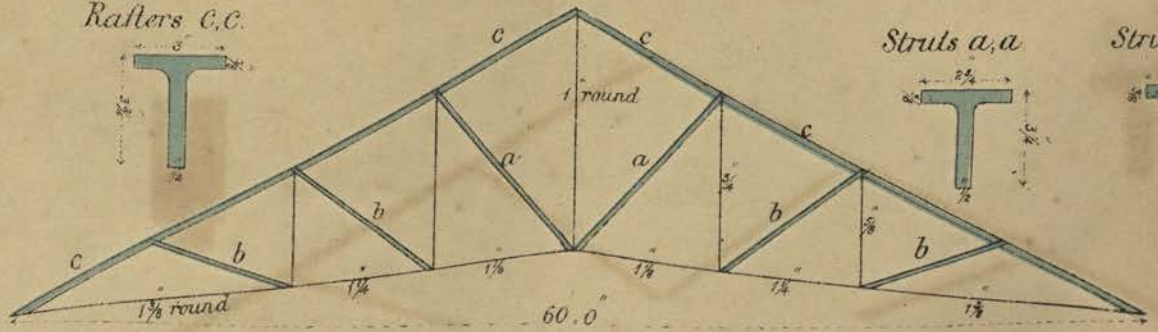
Fig: III



Struts b,b.

Fig: IV

Rafters C,C.



Struts a,a

Struts b,b.

Fig: V

Fig: VI

Plate XXV

Govt. Photozinco. Office, Poona. 1883

No.	14	gauge	weight	300 lbs.	per square.
„	16	„	„	260 „	„
„	18	„	„	236 „	„
„	20	„	„	190 „	„
„	22	„	„	150 „	„
„	24	„	„	130 „	„

Venetian Blinds.—In a plank about 4½″ wide and 1″ thick, screwed securely to the top of the opening, are cut slots to receive pulleys about 1″ diameter, either of brass or box-wood. Care must be taken not to make these slots wider than to permit of the pulley working freely.

Slots 1¾″ long ½″ diameter are also cut in this to receive rollers, round which tapes of cotton webbing fastened by brass-headed studs to the bottom of the top blade 3″ wide work freely.

Ordinary blades are about ⅜″ thick; the top blade should be somewhat thicker. The blades when blind is closed over overlap about ¾″.

The two cords by which the blinds are raised or lowered are fixed to the bottom blades; each pass through all the blades of the venetians and over two pulleys in top plank, and then are taken down and fastened or regulated at a hook in the jambs, or by patent clips which keep the blind up to any required height.

The ends of tapes about 1½″ wide of cotton webbing, are fastened to the top blade on either side of the holes through which the cords pass, and the blades are supported on narrow tapes the same length as the width of the blades sewn across from alternate sides of the broad tape; the bottom of the latter is fastened by brass-headed studs to the bottom of the lowest blade. Two tapes are generally sufficient, but if opening is broad, three are sometimes used.

PAINTS, WASHES, VARNISHES, &c.

Painting is to protect materials from the action of heat, gases, moisture, &c., by covering them with an almost impervious and durable coating. One of the most effective compositions used for this purpose is a mixture of white lead and linseed-oil.

The latter forms the durable coating; it possesses the property of drying after it has entered the surface of the materials into a resinous compound, thus filling up the pores and preventing decaying action. The "dryer", which is some oxidising substance such as litharge, is added to expedite the process, and a solvent such as spirits of turpentine is added to dilute the mixture; this soon evaporates again. The white lead gives body and opacity to the mixture; it combines readily and to a certain extent chemically with the oil into a saponaceous subtance. White lead is the carbonate of lead. It is a fine white powder weighing about 400 lbs. to the cubic foot. It is often adulterated by whiting, sulphate of baryta, etc. Tests.—Specific gravity,

or by resolving the powder back into metallic lead, which should weigh less than the powder; or, in the case of the sulphate of baryta to which is the most usual adulteration, by nitric acid which will dissolve the lead, but not the baryta. Linseed-oil in its natural condition dries slowly to the resinous varnish, and riather injures the brilliancy of delicate colours. Boiled linseed-oil also causes it to oxidise quicker, but, as it makes the oil thicker, is not so well suited for delicate work. Linseed-oil can be clarified by mixing it with an acid such as oil of vitriol; it must be well washed with water to get rid of the acid. In instances where the least yellowness in the oil would be injurious, nut or poppy-oil may be used with advantage.

Dryers.—Drying is an oxidising process. The ordinary dryer is "litharge" or oxide of lead. Oxide of manganese is also used, and is a quicker dryer than litharge. The proportion of litharge is about ¼ lb. to a gallon of oil. The oil is then called a drying oil, and can be made clear and colourless by leaving it exposed to the air in shallow vessels for two or three days. It should be observed that in the finishing coats of delicate colours, dryers are generally avoided, as they have a slight tendency to injure the colour.

Solvents are required to dilute the mixture of white lead and oil, which would not otherwise penetrate into the pores of the material. Spirits of turpentine is generally used for this purpose; it is a solution of resin in spirit, and evaporates perfectly. The best test for its purity is evaporation. It deteriorates by keeping.

Pigments.—The object of adding pigments to the drying oil is to give it opacity, body and colour.

Zinc White is the oxide of zinc; it is cheaper than, but not so durable as, white lead. It is light and not opaque, and is readily attacked by salts and therefore is not durable, and is easily acted on by wet and acids in wood. It does not dissolve so readily as white lead, and as long as it lasts it keeps its colour better than white lead, and is not so easily adulterated, it takes longer in drying, and when adulterated is liable to change colour. Lead dryers should not be used with zinc, as they become black when exposed to sulphuretted hydrogen; white sulphate of manganese is the best dryer.

Red Lead is the oxide of lead; on account of its durability it is frequently used as a priming or first coat on iron work; care should be taken that no salts are present.

In laying on the paint the white lead, oil and dryer are mixed to the consistency of thick cream on a flat stone, and the coating matter is then added. The brush should be held at right angles to the face of the work, so that only the ends of the hairs touch it.

The first or priming coat need have very little, if any, of the final colouring matter in it; after priming all nail holes, &c., are

stopped. For fine work each coat should be carefully rubbed down with pumice stone or glass paper, and dusted before the next coat is added.

Painting on Plaster.—Plaster, being more absorbent than wood, requires a greater number of coats to saturate the face, and that the 1st coat should be thinner, the plaster being quite dry and hard, and well sized.

The 1st coat is put on, consisting of white lead diluted with linseed-oil to a thin consistency, with a small quantity of litharge. The oil is entirely absorbed, thereby hardening the plaster to a depth of about ⅛ of an inch.

2nd coat is also thin, in order that the plaster may be thoroughly saturated.

3rd coat is thicker and contains a little turpentine with some of the colouring pigment.

4th coat is as thick as it can be used, equal parts of oil and turpentine being employed, with sugar of lead as the dryer. Finishing coat is frequently added of pure white lead diluted with spirits of turpentine only; a small quantity of Japanese gold size is sometimes used as a dryer, and the proper pigment to give the required colour is added. This coat, from its drying without any gloss, is called the flatting coat.

Painting old work.—If work is much soiled, it should be washed with soap and water and scoured; if foul with smoke and grease, it should be washed with lime and water and rubbed with pumice stone before the 1st new coat is laid on.

To remove old paint, use soft soap ½
Potass 1
Quicklime ½ or ¾.

The soap and potass are first dissolved by boiling in water, lime is then added, and the whole applied while hot, with a brush, covering all paint to be removed with the solution, which must be left on 12 to 24 hours, after which the whole of the paint will easily be removed by washing with hot water.

Old paint, however, can often only be removed by burning with a brazier.

The following is a table of materials required to cover superficial space as under:—

1st Coat ...	10 lbs. white lead. 4 pints linseed-oil. 2 ozs. of litharge. 1 oz. of red lead.	25 superficial yards, or say 2 squares.
2nd Coat ...	10 lbs. white lead. 2½ pints linseed-oil. 1½ „ spirits of turpentine. 2 ozs. of litharge.	40 superficial yards, or say 3⅓ squares.
3rd and subsequent Coat.	10 lbs. white lead. 2 pints linseed-oil. 2 „ spirits of turpentine. 2 ozs. of litharge.	50 superficial yards, or say 4½ squares.

For coloured paints add colour in proportion of 1 lb. to 2 lbs. for every 10 yards of surface, reducing white lead in proportion.

1 oz. of Olphert's oxide with ½ oz. of raw linseed-oil (patent dryers or not as required) will cover a square yard.

$\frac{1}{16}$ resin to 1 of Olphert's paint is a capital dryer.

Glazier's putty is made of whiting and oil. Whiting in form of a very dry fine powder mixed with as much raw linseed-oil as will form it into a stiff paste; this, after being well pounded, should be left for 12 hours and worked up in small pieces till quite smooth. It should be kept in a glazed pan and covered with a wet cloth. If putty becomes hard and dry, it can be restored by heating it and working up again while hot. For special purposes white lead is sometimes mixed with the whiting, or putty is made of lead and litharge entirely.

Distemper is the name given to paint composed of white lead or other colouring matter ground in water instead of oil and mixed with size to make it set; it is, in fact, a water colour. The colouring materials chiefly employed are *red* and *yellow ochre*, the flowers of the *dhak* tree, the red earth called *hirmzee*, *orpiment*, *indigo*, and *blue vitriol*.

Whiting is pure chalk reduced by levigation to fine powder.

Size is the glue extracted from animal tissue; it is often used by itself as a priming coat.

Colour washing.—The following description of colour washing refers to this kind of work as executed in Calcutta, and a few récipes are given of some of the most favourite colours. When the walls are rough and not lime-plastered, they are to be enamelled with lime-plaster, so as to make the surface smooth. The thick curd or Chânâ mixed with lime water, or simply milk and water of equal proportions, is to be washed over the surface to form a body for the water colouring.

The water colour to be mixed with ½ milk and ½ water with white of egg and pure China glue, the latter previously boiled in water and made into liquid. The colour so prepared to be laid carefully on the walls in one coat with an English brush, so that no cut shades be visible on the walls.

By using stencil plates of zinc or stiff cardboard, flower or other patterns can be used for borders round doors, &c., with great effect, at a very moderate cost.

Statement showing ingredients for different descriptions of water colouring, borders, &c.

Stone colour ...	Whiting	1 seer.
	Umber burnt	½ chittack.*
	Chrome yellow	2 ,,
	Glue	2 ,,
	Vermilion China	½ tolah.
Canary ...	Whiting	1 seer.
	Glue	2 chittacks.
	Chrome yellow	2 ,,

* Chittack is the $\frac{1}{16}$ of a seer.

Buff ...	Whiting powder	1 seer.
	Glue	2 chittacks
	Chrome yellow	2 ,,
	Yellow ochre	1 ,,
Green ...	Whiting	1 seer.
	French green	4 chittacks.
	Glue	2 ,,
Brown ...	Whiting	1 seer.
	Glue	2 chittacks.
	Burnt umber	2 ,,
	Meena	2 ,,
Blue ...	Whiting	½ seer.
	Glue	2 chittacks.
	Prussian blue	2 ,,
Purple ...	Whiting	1 seer.
	Glue	2 chittacks
	Meena	2 ,,
	Vermilion China	2 ,,
Fine white-washing 2 coats.	Stone lime	¼ chittack.
	Water lime	1 seer.
	Shell lime	¾ ,,

A récipe for white-wash which does not easily rub off on the clothes :—

'1 maund clean white or shell lime, slake it thoroughly with hot water in covered vessel.

Add 5 seers salt dissolved in hot water.

3 seers coarse rice pounded or boiled to a thick paste.

½ seer glue cleaned by dissolving in hot water, the dirty refuse being rejected.

Ingredients to be well mixed and brought to the required consistency by the addition of hot water, then allowed to simmer over a fire for a few hours ; then strain and lay on hot.

Varnishes.—The following compositions make approved varnishes :—

Sandarach	250 parts.
Mastic	64 ,,
Elemi resin	32 ,,
Turpentine	64 ,,
Alcohol (spirits of wine) ...	1,000 ,,
Copal	300 ,,
Oil of turpentine	500 ,,
Linseed oil	200 ,,
Amini resin	2 lbs.
Litharge	1 oz.
Sugar of lead	1 ,,
Turpentine	5½ qts.
Linseed-oil	3 ,,
Pale shellac	750 parts.
Mastic	64 ,,
Spirits of wine	1,000 ,,

These are carefully boiled and strained. The linseed-oil used for this purpose is prepared as a drying oil.

French Polish.—Take plaster of Paris, red ochre or dragon-blood (sufficient to tint it), linseed-oil ; mix with a stiff paste, moisten a piece of rag with linseed-oil, rub on wood, and then apply mixture sparingly, rubbing it hard in to fill up pores of

the wood. Let stand for a few hours and then rub down with fine glass paper. Then put on the polish. Two coats will be sufficient. To finish off, roll a piece of flannel into the form of a rubber, cover with a piece of rag slightly damp with methylated spirit, and rub lightly and quickly with a circular motion; if the rag sticks, touch the wood with linseed-oil. French polish is made by dissolving ¼ lb. brown shellac in 1 pint of spirits of wine or naptha.

The following is an excellent wood or furniture polish :—

16 qts. Linseed-oil.
2 ,, Spirits of wine.
1 ,, Vinegar.
1 ,, Turpentine.
1 ,, Copal varnish.
1½ pints Muriatic acid.

The oil to be heated and the whole mixed up.

Brass Lacquer.

Pale shellac	... 1 lb.
Gamboge	... 1 oz.
Cape Aloes...	... 3 ,,
Alcohol	... 2 gals.

Gold Lacquer.

Pale shellac	... ¾ lbs.
Sandarach	... 3½ ,,
Turmeric	... 1 ,,
Gamboge	... 2½ ozs.
Alcohol	... 2 gals.

Lacquered Brass, to clean.—Rub with a soft cloth dipped in stale beer when the cloth works dry, dip again; this gives a good polish.

CONCRETE ARCHED ROOFING.*

Class of building in which used.

A considerable number of police quarters, chowras, and other small buildings in the Kaira Division have been roofed with concrete arching at a cost not exceeding that of ordinary tiled roofing, and with a large saving in maintenance charges.

Span.

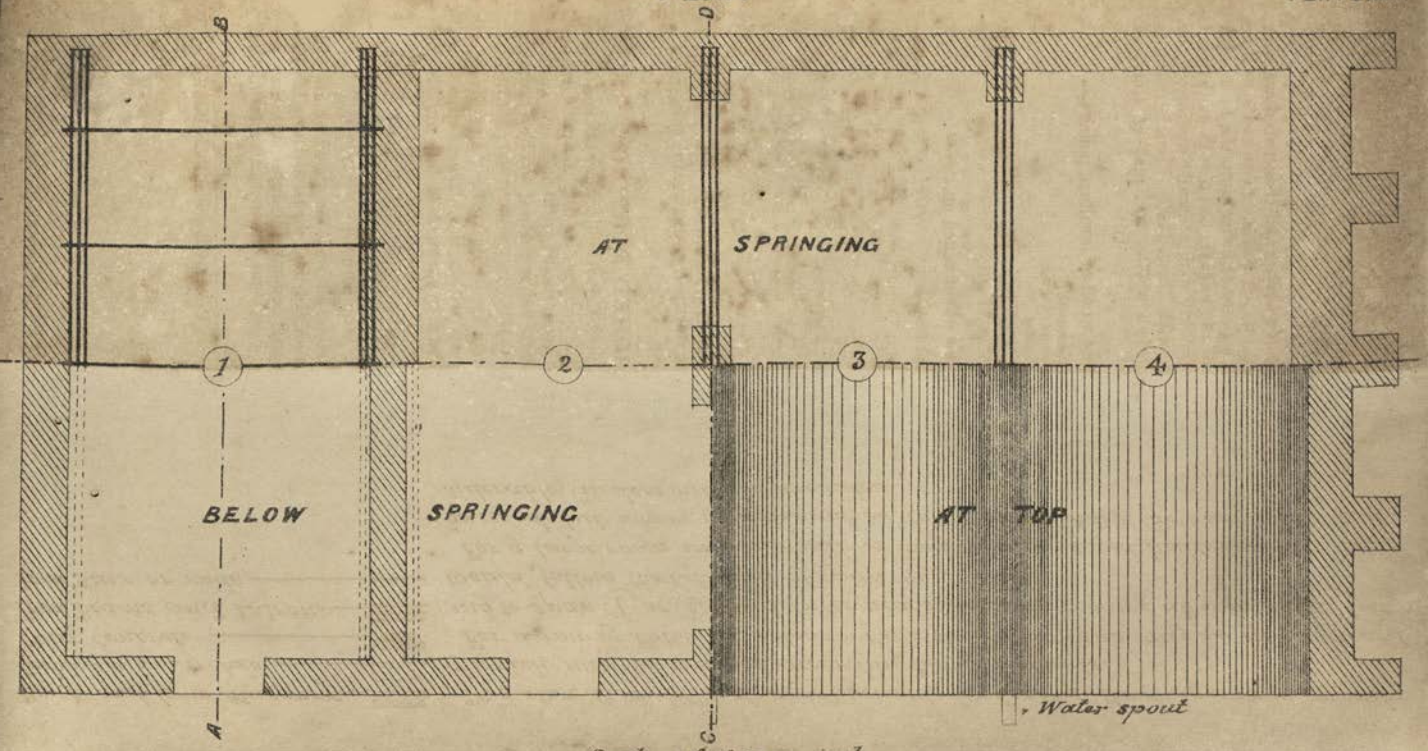
The limit of span hitherto has been (10) ten feet, and in order to keep within this, larger spaces are divided into spans of 10 feet or less, by means of wrought-iron beams. Double-headed railway rails (60 to 75 lbs. per yard) make cheap and useful girders when small bearings can be arranged for, and in other cases rolled iron beams of suitable section have been adopted.

Rise of arches.

A rise of 2 inches to the foot is allowed for spans of 10 feet and under, if lime concrete is used. For Portland cement Concrete this may be reduced, and for 6 feet arches in cement one inch rise per foot of span has been found sufficient.

* Communicated by T. Little, Esquire, Executive Engineer, Kaira District.

PLAN



Scale 5 feet to an inch

Brick and lime Masonry
Concrete in Arches
Other Concrete
Iron Beams and L Iron
Iron Bars or rods

This plan shows several arrangements for Concrete Roofing one or more of which may be adopted according to requirements.

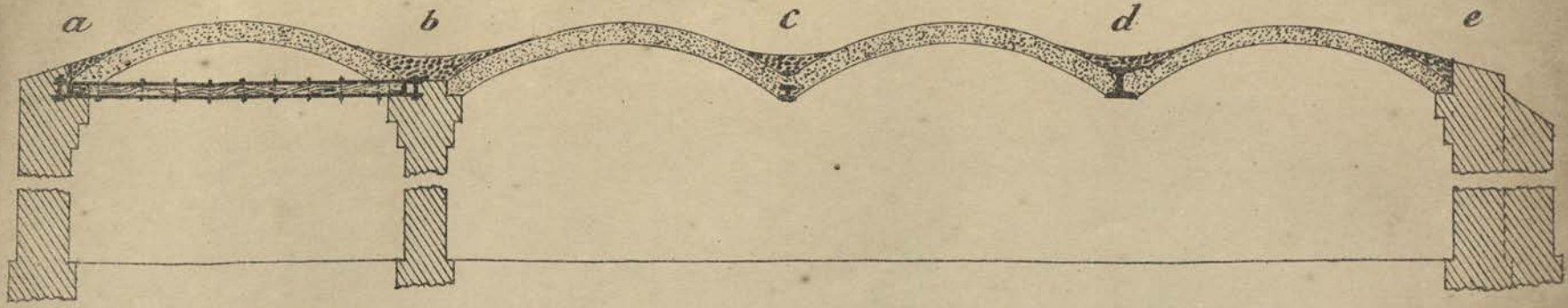
For a row of Police Quarters or Cells, the end spans may be either according to span (1) or (4), and intermediate spans require no iron work but would follow the left half of span (2).

For a large room in which pillars may be introduced Railway rails can be used, but where this cannot be done and where the bearing is considerable, Girders must be provided.

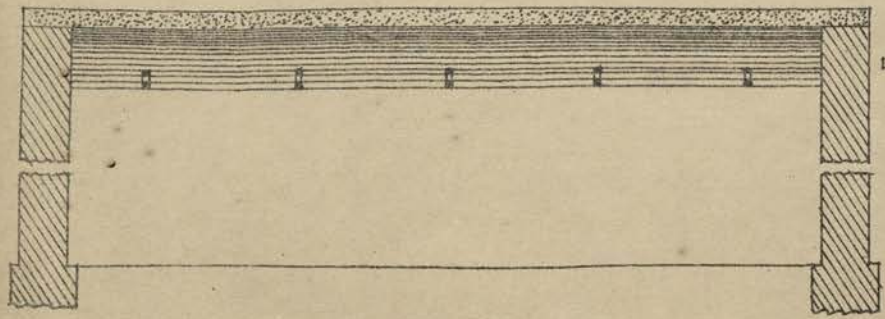
Photozincographed, Govt. Office, Poona, 1882

For references see plate 31.

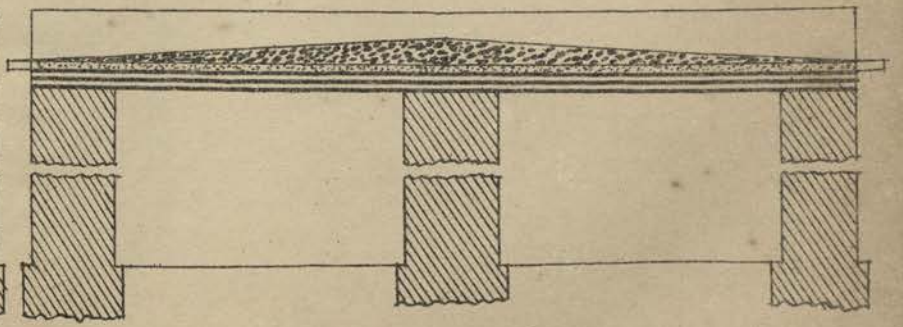
LONGITUDINAL SECTION



SECTION ON A.B.

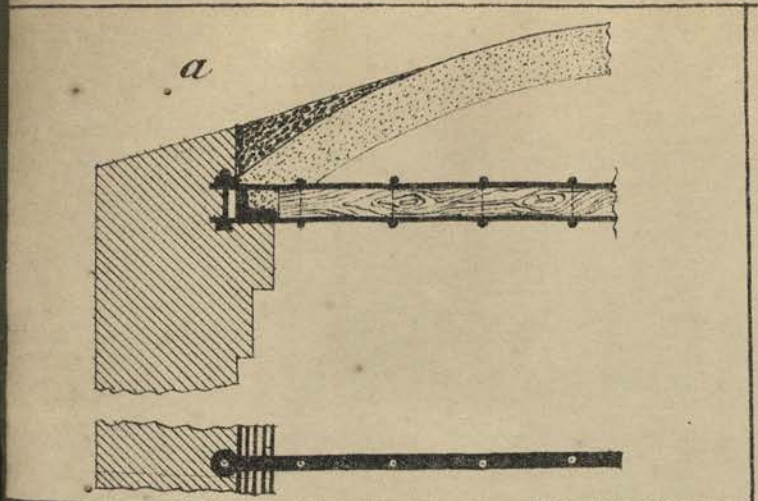


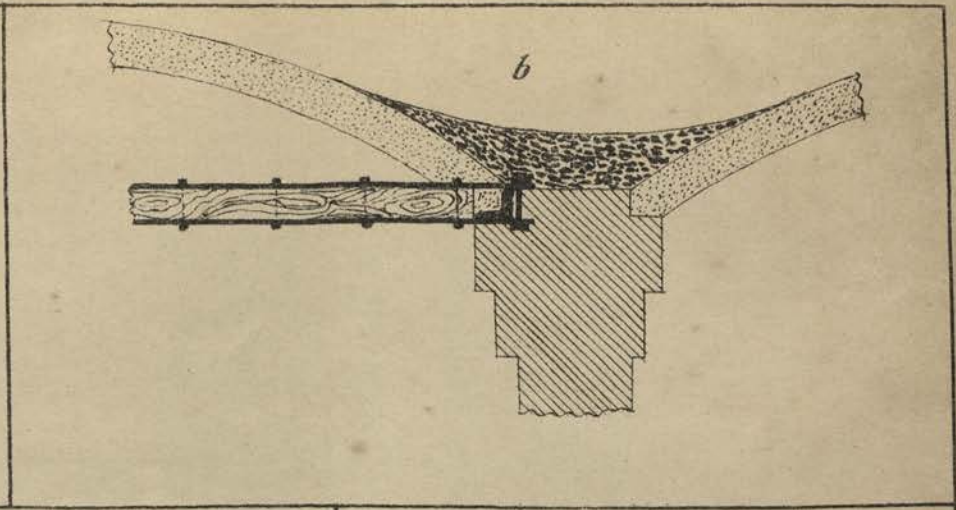
SECTION ON C.D

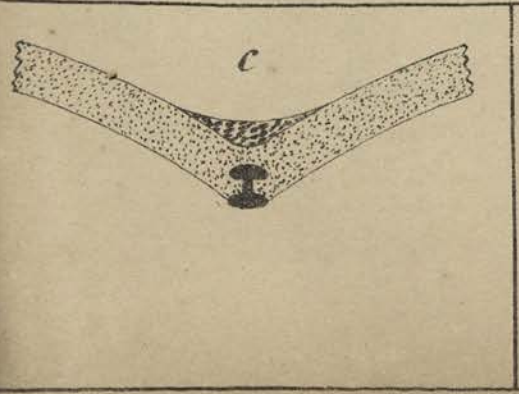


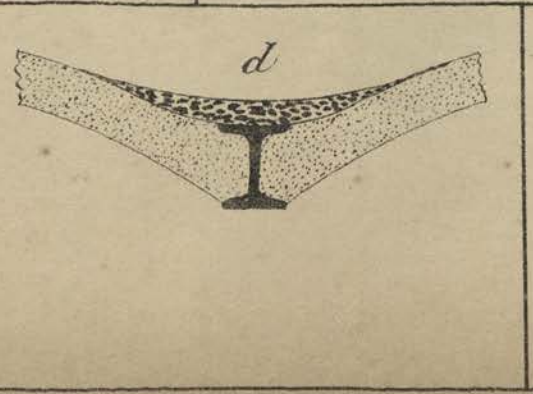
Scale 5 feet to an Inch

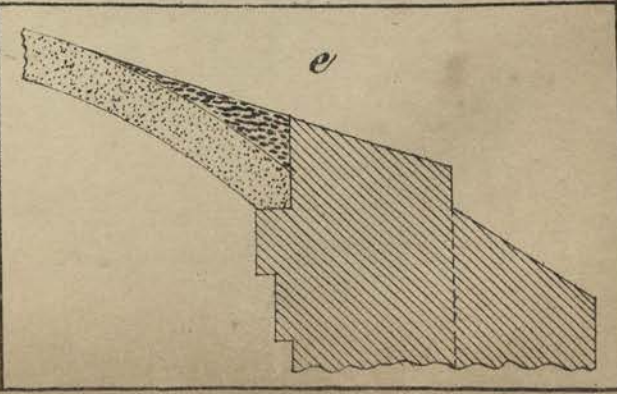
Govt. Photozinco: Office, Poona. 1882











Scale 2 feet to an Inch

Thickness of arches.

For 10 feet arches 6″ of good lime concrete is enough, though occasionally a thickness of 7½ inches has been given. For smaller arches 4½ to 6 inches is required, though less than 6″ should only be given when cement is used.

Abutments.

Either the outer walls carrying end arches must be made strong enough to act as abutment, or the horizontal thrust of end arches must be taken either by L iron and tie rods as shown in the accompanying Plates, or by some other similar arrangement. In a series of arches this tieing is only necessary for the two end spans, and the ties may be either simple iron rods, or, if greater stiffness is required, double bars with timber between as explained in sketches. The ties must be fixed to the angle irons with properly designed joints, which will vary according to circumstances.

Intermediate arches.

In the case of a series of arches on cross walling or girders, either of the methods shown in explanatory sketches may be adopted, and water can be carried off roofs by sloping the backing over haunches so as to form gutters.

Centring.

Centring may be either fixed, or on sand bags or wedges in order to facilitate removal. The centrings should not be removed in less than 20 days, and it is better to allow a clear month. Ordinary bridge centrings are used and cost in Kaira about Rs. 10 to Rs. 12-8-0 per 100 superficial feet. The curve of the intrados is rendered true by means of a layer of plaster, or accurately shaped laggings may be used and covered with sheet zinc if the number of arches is sufficient to admit of this without undue cost.

Concrete.

Should be composed of—

(1) Thoroughly burnt lime of good quality.

(2) Sharp clean sand.

(3) An aggregate which may be either broken stone, ballast, kankar, or broken brick.

Ballast or porous stone forms the best aggregate, and brick is not recommended if any better material can be obtained, as it is liable to pulverization in ramming. In the Kaira Division the most satisfactory results have been obtained by mixing the lime and sand into good mortar similar to that used in building, and composed of 1 to 2 parts of the latter to one of the former, the precise proportion depending on the quality of lime. To one measure of this mixed mortar is added 2 to 3 measures of the aggregate, which should be of a size to pass through a ring 1″ in diameter; all dust to be rejected, and the material to be clean and wet at the time of mixing. The mixing to be done very thoroughly on platforms and not more than ½ to ¾ of a cubic yard

to be mixed at one time on one platform. If the lime is very fat in quality it may be desirable to use a proportion of soorkhi with the sand.

Spreading concrete.

The centring having been prepared, the rough plastered or other surface should be wetted, and should then have pounded brick sprinkled over it to a depth of about $\frac{1}{8}$ to $\frac{1}{12}$ of an inch, and on this half an inch of lime plaster to be spread, and then the concrete, the plaster and the concrete to be carried on together, the former being slightly in advance of the latter. The effect of this is that the concrete adheres to the plaster which forms the under side of it, and the pounded brick is the dividing layer, some of which remains on the centring below and the balance adheres to the arch above. The spreading and ramming to go on from both haunches simultaneously towards the crown. If the arch is not more than 6 inches in thickness, it should be completed in one layer and in one day, but if over 6 inches it may be made in two or more layers, each layer to be finished up in the day, and the top of lower layer to be roughened before the upper is added. Very thorough ramming is necessary at the time of spreading, in order to get the work solid and compact, and the newly formed arches should be kept wet by means of a layer of grass, straw, or leaves, which should be watered each day for a month.

Expansion.

In a very long series of arches it may be desirable to allow for expansion, and this can be done where required by inserting an inch plank at back of arch near springing. The plank to be removed immediately the work has set sufficiently to admit of this, and the space should be grouted after an interval of two or three days. It is seldom that this precaution will be required in arches with lime concrete.

Plastering.

Arches to be roughly plastered below, and to be plastered above with good lime plaster similar to that used for flat roofs, and a wash or thin layer of cement may be given over the plaster if found desirable, but this is not usually required.

Front, rear, and partition walls.

These walls may be built solid, or where ventilation is required the tympanum portions may be filled in with tile pipes laid with an upward slope so that water may run off outside. All such walls running up to intrados of arches should be carried out after the centring has been removed and the arch has fully settled, for otherwise the walls would lead to cracks.

Verandahs.

Verandahs may be of planking or tiled, but there should be a string course just above top of tiles or planking to prevent water running down face walls.

This filling may be of ordinary concrete of good quality, and the upper surface to be plastered over in the same manner as described for extrados of arches.

Filling over arches at haunches.

Cost. The cost of concrete arching of the description referred to, excluding iron work but including centring and plastering per 100 superficial feet (in the Kaira Division), is found to be nearly as shown in margin.

	Rs.	Rs.
Lime concrete 6" in thickness for 100 superficial feet of roof	10 to	13
Centring	10 to	13
Plastering above and below	5 to	7
Contingencies	1 to	2
Total for 100 superficial feet ...	26 to	35

Mode of measuring. Concrete roofing is measured flush from outside to outside of walling, while in tiled roofing the eaves must be added plus the extra for slopes, and for small buildings it will be found that 100 superficial feet of flat concrete roofing would be represented by from 130 to 150 superficial feet of tiled roofing.

Comparison of cost. Double tiled roofing with teak framing for small spans costs Rs. 30 to 40 per 100 superficial feet in the Kaira Division, but by calculating the area in the same way as for concrete roofing (outside to outside of walls and no slopes) the rate would be increased to from 40 to 60 Rupees. The cost for covering 100 superficial feet (similarly meaured) is therefore for tiled roofing Rs. 40 to Rs. 60 and for concrete arched roofing Rs. 26 to Rs. 35 excluding iron work. The cost of iron work, or of extra masonry in abutments if iron is dispensed with, must be added, and the amount of this additional item depends on the circumstances of each building, but for a series of police quarters or cells or similar structures it is found in practice that the total cost of concrete roofing is generally about the same as for double tiles and teak-wood, though in favourable cases it is sometimes less.

Repairs. The main advantage of this concrete construction is that the roofs require practically no repairs, and experience gained in constructing and maintaining more than 25,000 superficial feet in the Kaira Division during the past 12 years has established its economical character in this respect. Occasionally the plaster requires looking to, and small cracks have to be filled in as in flat roofs, but in many instances, during the 10 to 12 years referred to, nothing whatever has been necessary.

General. Some experiments have been tried at Kaira with arches of 20 feet span of concrete formed with lime, and also with Portland Cement, and with a mixture of the two. These arches have been made from 4 to 6 inches in thickness, but have been strengthened with iron framing. One of them has been loaded for several years with 150

lbs. to the superficial foot and is quite sound. The cost of these does not exceed that of tiled roofing for similar spans, and may possibly be still further reduced, but more experiments are desirable before practically extending this system of roofing to spans above 10 feet. When cement is used it is necessary to mix the materials dry, and to add the cement and water just before the concrete is required.

Old concrete roofs.

Flat roofing of concrete (without timber) is found in some of the old Mahomedan buildings in Gujarát.

CODE OF RULES FOR THE ERECTION OF LIGHTNING CONDUCTORS.*

The following code of rules should be carefully attended to in drawing out a specification for a lightning conductor :—

Points—The point of the upper terminal should not be sharp, not sharper than a cone of which the height is equal to the radius of its base. But a foot lower down a copper ring should be screwed and soldered on to the upper terminal, in which ring should be fixed three or four sharp copper points, each about 6 inches long. It is desirable that these points be so platinized, gilded, or neckel plated as to resist oxidation.

Upper Terminals.—The number of conductors or points to be specified will depend upon the size of the building, the material of which it is constructed, and the comparative height of the several parts ; no general rule can be given for this. It must be borne in mind that even ordinary chimney stacks, when exposed, should be protected by short terminals connected to the nearest rod, inasmuch as accidents often occur owing to the good conducting power of the heated air and soot in a chimney.

Note.—The conference remarks as follows in regard to the space protected by each lightning rod :—"At present we have not sufficient data to enable us theoretically to calculate the space protected by a lightning rod, and therefore we are compelled to draw up our rules upon the question entirely from experience, and here we find that, with the doubtful exceptions already mentioned, there is no recorded instance of a building being struck by lightning within a conical space the radius of whose base was equal to its height, and we think that the adoption of this rule may reasonably be expected to yield that security in the future which, as far as we know, it has done in the past."

Insulators.—The rod is not to be kept from the building by glass or other insulators, but attached to it by metal fastenings.

Note.—"The essentials are (1) that the rod be attached to the building by fastenings of the same metal as itself ; (2) that the fastenings be of adequate strength ; (3) that they be of such form as not to compress or distort the rod ; (4) that they allow play for its expansion and contraction ; (5) that they hold it firmly enough to prevent all the weight falling on any one bearing."

Fixing.—Rods should preferentially be taken down the side of the building which is most exposed to rain. They should be

* From the "Report of the Lightning Rod Conference" published in London in December 1881.

held firmly, but the hold fasts should not be driven in so tightly as to pinch the rod, or prevent the contraction and expansion caused by changes of temperature.

Factory Chimneys.—These should have a copper band round the top, and stout, sharp copper points, each about one foot long, at intervals of 2 or 3 feet throughout the circumference, and the rod should be connected with all bands and metallic masses in or near the chimney. Oxidation of the points must be carefully guarded against.

Ornamental Iron-work.—All vanes, funnels, ridge iron work, &c., should be connected with the conductor, and it is not absolutely necessary to use any other point than that afforded by such ornamental iron work, provided the connection be perfect and the mass of iron work considerable. As, however, there is risk of derangement through repairs, it is safer to have an independent upper terminal.

Material for Rod.—Copper, weighing not less than 6 ozs. per foot run, and the conductivity of which is not less than 90 per cent. of that of pure copper, either in the form of tape or rope of stout wires—no individual wire being less than No. 12 B. W. G. Iron may be used, but should not weigh less than 2¼ lbs. per foot run.

Note.—The conference recommend the following as the *minimum* size of each :—

Material.	Pattern.	Diamr.	Area.	Weight per foot.
Copper	... Rope ...	½″	... ·10	... 6 ozs.
,,	... Round rod ...	⅜″	... ·11	... 7 ,,
,,	... Tape ...	¾″ × ⅛″	... ·09	... 6 ,,
Iron	... Round rod ...	$\frac{9}{10}$″	... ·64	... 35 ,,

Joints.—Although electricity of high tension will jump across bad joints, they diminish the efficacy of the conductor; therefore every joint, besides being well cleaned, screwed, scarfed, or rivetted, should be thoroughly soldered.

Note.—"Screwed, scarfed, and rivetted joints, however well they may be made mechanically, are certain to rust and corrode in time, owing to the expansions and contractions due to changes of temperature admitting moisture, and thus causing corrosion and resistance. No joint can possibly be electrically perfect that is not *metallically continuous*, and carefully soldering in addition to screwing, scarfing, and rivetting is the only certain mode of securing this. Soldering is a method that has borne the test of experience, and its success as a means of securing perfect joints leaves no excuse for its omission. The fewer joints the better, but where there are joints they can only be made electrically secure by careful soldering."

Protection.—Copper rods, to the height of 10 feet above the ground, should be protected from injury and theft, by being inclosed in an iron pipe reaching the same distance into the ground.

Painting.—Iron rods, whether galvanized or not, should be painted : copper ones may be painted or not according to architectural requirements.

Curvature.—The rod should not be bent abruptly round sharp corners. In no case should the length of the rod between two points be more than half as long again as the straight line joining them. Where a string course or other projecting stone work will

admit of it, the rod may be carried straight through, instead of round the projection. In such a case the hole should be large enough to allow the conductor to pass freely, and allow for expansion, &c.

Extensive masses of Metal.—As far as practicable it is desirable that the conductor be connected to extensive masses of metal, such as hotwater pipes, &c., both internal and external; but it should be kept away from all soft metal pipes, and from internal gas pipes of every kind. Church bells inside well protected spires need not be connected.

Earth Connection.—It is essential that the lower extremity of the conductor be buried in permanently damp soil; hence proximity to rain water pipes and to drains is desirable. It is a very good plan to make the conductor bifurcate close below the surface of the ground, and adopt any of the following methods for securing the escape of the lightning into the earth:—

A strip of copper may be led from the bottom of the rod to the nearest gas or water main—not merely to a lead pipe—and be soldered to it; or a tape may be soldered to a sheet of copper 3 ft. × 3 ft. and $\frac{1}{16}$ inch thick, buried in permanently wet earth, and surrounded by cinders or coke; or many yards of the tape may be laid in a trench filled with coke, taking care that the surfaces of copper are, as in the previous cases, not less than 18 square feet. Where iron is used for the rod, a galvanized iron plate of similar dimensions should be employed.

Inspection.—Before giving his final certificate the architect should have the conductor satisfactorily examined and tested by a qualified person, as injury to it often occurs up to the latest period of the work from accidental causes, and often from the carelessness of workmen.

Collieries.—Undoubted evidence exists of the explosion of fire damp in collieries through sparks from atmospheric electricity being led into the mine by the wire ropes of the shaft and the iron rails of the galleries. Hence the head gear of all shafts should be protected by proper lightning conductors.

Dated December 14th, 1881.

Memoranda on the Management of Portable Engines by Messrs. Ransome and Sims, of Ipswich.

Extracted from "Working Drawings and Designs," and originally published in Royal Agricultural Society's Journal.

"**Preparing Engine for work.**—Place the Engine as nearly dead level as possible, and in such a position that the dust from the work may not be blown upon it. The wheels should all have an even bearing on the ground, so as to prevent any rocking motion when at work.

"**Filling the Boiler.**—Care should be taken to procure water as clean as possible for the use of the Engine; water from dirty ponds or ditches should be avoided. The water must be poured into the boiler through the opening provided for that purpose (by means of an iron funnel generally furnished with the Engine), till it appears about half way up the glass gauge-tube.

"**Glass Water-gauge Apparatus.**—The Water-gauge cocks should always be tried, before the fire is lighted, to ascertain that there is no obstruction in the passages, which would prevent the water finding its proper level in the glass tube. In case the water does not appear to move freely in the tube, on opening the small cock at the bottom of the gauge, take out the two screws opposite the passages to the boiler, and insert a wire through the holes into the boiler till the water issues freely; the screw-plugs may then be put in again, and the fire lighted. Great care should be taken to prevent either of the cocks between the boiler and the glass tube becoming shut when the fire is burning and the steam up.

"**Lighting the Fire.**—The firebars must be well cleaned from dirt and clinkers before the fire is laid; a few dry chips or shavings and a small quantity of firewood should then be spread over the bars and some small coal scattered over them; a light may then be applied to the shavings from beneath the gratebars, and the fire will soon burn briskly; with some fuel it is better to place the firedoor a little way open till the coal is ignited; coal may then be put on in small quantities at a time, the firebars being kept covered to a depth not exceeding 3 inches; the fire must be clear, but the bars must not be allowed to become bare of coal in places, for the cold air will then pass through the tubes and check the formation of steam; all wet straw and damp wood should be avoided for lighting the fire. As soon as the fire is lighted, a few pails of water should be poured into the ashpan; it tends to prevent the formation of clinkers, and greatly preserves the firebars by keeping them cool; it also decreases the danger of fire in the workyards, because all the hot cinders, as they fall from the grate, are instantly extinguished; if the weather be very windy, it may be necessary to close one of the doors of the ashpan and to open the other; experience will soon point out which door should be closed.

"**Raising Steam.**—The fire as it burns up, should be kept thin and bright; the coal must never be heaped up against the tubes; too much coal should not be thrown on at a time, or it will tend to delay the production of steam; a careful Engineman will soon find out the best mode of firing with the different description of coal he will be required to use.

"**Brushing out Tubes.**—If the coal is bad, or of a kind which emits a large quantity of smoke, the tubes should be well brushed out during the dinner hour; this can easily be done without dropping the fire by allowing it to burn low, and raking it into one corner of the grate. The tubes may be easily brushed out from the smoke-box end. Before commencing to light the fire in the morning the tubes must always be brushed out.

"**Safety-valve and Spring-balance.**—As soon as the water begins to boil, the safety-valve should be opened by hand and examined, to make sure that it is not obstructed in any way; the spring-balance may then be screwed down to about 10 lbs.; and when the steam blows off at that point it may be gradually screwed down to 45 or 50 lbs., as the steam arises. The spring-balance should on no account be left always screwed down to the full pressure when the Engine is not at work and the steam not up, because the elasticity of the spring is thus destroyed; and it is very possible, if the Engine remains long out of use, that the valve may become set-fast, which would cause danger when the steam was next got up.

"**Oiling the Engine.**—Before starting, put a little oil into the cylinder through the cock provided for the purpose, and move the Engine round by hand, by means of the fly-wheel, to ascertain that it is all in working condition; all the oil-cups must be filled up, and the syphon-wicks examined to make sure of their being in good condition. A little oil should be put upon the guidebars themselves, as well as into the oil-cups attached to them; the pump-plunger and all the eccentrics must also be oiled.

"**Starting and Working the Engine.**—The piston should be placed at about the half stroke, and the regulator-valve opened gradually, the two relief cocks on the cylinder being previously opened; after the Engine has made a few revolutions these cocks may be shut, and the regulator-valve set full open, so that the speed of the Engine may be controlled by the governors. The feed-pump should be tried as soon as the Engine is in motion, to ascertain that it is in working condition before the water has had time to diminish. To set the pump to work the suction cock may also be opened, and shut a few times; and the small pet-cock must also be opened and shut a few times; if the water does not issue from the pet-cock at every stroke from the plunger, the finger should be applied so as to stop the hole in the pet-cock for a few strokes and then be taken off again; this operation should be performed that the hole may be closed by the finger on the plunger going out of the barrel of the pump and opened on the return stroke, when the plunger is forced in again. If, after repeated trials, no water is thrown by the pump, and steam or hot water only issues from the cock, something is wrong with the valves, and they must be carefully examined.

"**Pump out of order—Valves to be examined.**—The Engine must be stopped, *the cock connecting the feed-pipe to the boiler must be shut*, the covers of either or both valves may then be taken off, and the valves examined or cleaned; *the Engine must on no account be moved round after the valve covers are put on again before the cock connecting the feed-pipe to the boiler be opened, or the pump and pipes may be seriously damaged.* The use of this cock is to enable the pump-valves to be examined when the steam is up without the danger of scalding those about the Engine.

"**Supply of water to Boiler.**—It is desirable to have a constant supply of water always going into the boiler from the feed-pump; a little experience will soon point out to the Engineman how

far the cock requires to be open to enable him to do this; the plan of shutting the feed quite off for some time, and then turning it full on, should never be adopted, for by this means the formation of steam is rendered irregular, and much fuel wasted.

"**Mode of Firing.**—The fire must be kept constantly bright and clear; the bar must be covered, but never more than 3 inches thick, and the coals must not be heaped up against the mouths of the tubes; coal must be put on the fire in small quantities, and frequently, and not all at once, and then allow the fire to burn quite low; experience will show how often the fire must be supplied with coal, as it much depends upon the quality of the coal and the amount of work that the Engine is doing.

"**Water Low in Boiler.**—There should never be less than 2 inches of water visible in the glass gauge-tube when the Engine is at work; if by accident or neglect the water should become so low as only to show about half an inch in the glass tube, the fire should instantly be dropped; by lifting the firebars, from their places by means of the tools furnished for the purpose, the burning coals will fall into the water in the ashpan and be extinguished; water should never be thrown into the firebox; the fire must on no account be again lighted until the boiler has been filled up, which may be done after the steam has gone down.

"**Bearings to be Oiled and Examined when Engine is at Work.**—The bearings and guidebars should be carefully examined from time to time to see that they are properly supplied with oil from the lubricators attached to them; it is a good plan to put a little extra oil upon the guidebars in addition to filling the lubricators upon them. Whenever the Engine is stopped, all the bearings should be felt, to make sure that they have not heated; if there be any disposition to heat, the bearings having such a tendency may be loosened a little, but they must not be too slack or it will occasion a disagreeable knocking, which is very injurious; sometimes it becomes necessary to take the top brasses quite off to free them from grit, which will cause heating in the brasses, the parts requiring most attention are the two ends of the connecting-rod and the bearings of the crank-shaft; the eccentrics, also, should be oiled occasionally when the Engine is working; the brass rings should be slackened a little if they become warm; after taking the cap off a bearing, care must be taken that on replacing it, it is not screwed down too tightly, or it will be sure to cause friction and increase the mischief sought to be avoided.

"**Preparations for moving the Engine.**—When the day's work is over, and the Engine is going to be moved to another place, the water should be run out of the boiler when the steam is quite down; *the practice of blowing all the water out of the boiler directly the fire is dropped is a very bad one,* for the sudden contraction of the tubes caused by the rapid cooling makes them leaky, and does much mischief; *the boiler should never be refilled when hot*

for the same reason. The water should never be left in the boiler, when the Engine is going to travel over a hard road; if it is merely going to be moved on soft ground for a short distance no harm will be done beyond adding greatly to the weight; care should be taken that the firebars do not shake out, and thus be lost, when the Engine is travelling. After this the funnel is folded down, and the Engine is again in a travelling condition.

"**Governor Balls.**—It is a good plan to take the levers carrying the balls off when the Engine is going to travel, as the jolting on roads is very apt to break these levers; they may be carried conveniently in the smoke-box, wrapped up in hay or shavings, to prevent injury.

"**Road Wheels to be occasionally examined.**—Before the Engine travels any great distance the road wheels are to be taken off, and the axles examined and cleaned. If the axles are much cut they should be dressed over with a smooth file to take off all roughness; they should be well greased with a mixture of oil and melted fat before going on a journey; and if the journey be long, the small screws in the naves of the wheels should be occasionally taken out, and fresh oil be poured into the axle-boxes.

"**Cleaning Engine.**—The next thing to be observed is the cleaning of the Engine, which must be conducted with great care, omitting nothing, as the slight trouble of cleaning an Engine after each day's work is amply repaid in saving the grinding of journals and brasses from an accumulation of dirt; in short, an Engine in this respect resembles very much a human being; if it is required to be in good health—so to speak—it must of necessity be kept perfectly clean. After the day's work is done the Engine should be well rubbed over with cotton waste, and all dust and grit should be removed, also all superfluous oil which may have accumulated during working; the chimney should be lowered down and the Engine be covered over with the tarpaulin furnished for that purpose; the Engine should always be carefully covered up when travelling to prevent the working parts becoming injured by dust or mud.

"**Washing out Boiler.**—The boiler must be well washed out and cleansed after about twelve or fourteen days' working; to do this the brass plugs and mud doors round the bottom of the outside shell of the firebox must be taken out, the water must be poured freely into the boiler through the opening where water is poured in, the mud and scales being at the same time loosened and pulled out with a small iron rod, the end of which should be made like a hoe; at the same time the plug beneath the tubes in the smoke-box should be taken out and the manhole-cover be lifted off, a long rod being pushed backwards and forwards through the hole under the tubes, so as to loosen the dirt and sediment. Water should be poured into the manhole plentifully, so as to wash out all that may be collected in the boiler through the various mudholes, which should all be open during this operation. On again putting in the

brass plugs, be careful not to cross the threads; they may be entered with the fingers only, and not screwed up with a spanner until they have been screwed several turns by hand.

"**Preparing the Engine for lying out of work for a considerable time.**—If the Engine is not going to be used for a length of time (say a month), the cylinder-cover should be taken off, and the cylinder well rubbed dry, and oiled; the fly-wheel should then be turned round a few times by hand to ensure every part of the piston and slide becoming well covered with oil; the cylinder cover may then be put on again; the joint only requires a little redlead cement to be spread around it, but the redlead must not be so placed as to squeeze into the cylinder itself when the cover is screwed up; care must be taken to screw the bolts up very equally. The whole of the bright work of the Engine must be well dressed over with a mixture of whitelead and hot tallow, put on with a painter's brush. The packings from the piston-rod, slide-rod, and pump-plunger should be taken out, for they injure the rods by causing corrosion to take place from the moisture of hemp packing.

"**Packing the Engine.**—This operation cannot easily be described, and must be seen to be comprehended thoroughly; the Engineman, who is sent from the works with the Engine, will probably instruct the person who is about to take charge of the Engine how to do the packing; but this and many other things require practice to do them properly. None but the best white spun-yarn and white hemp must be used for packing, and it must be quite free from all gritty particles. The packing, before being put into the stuffing-boxes, must be well soaked in hot tallow.

"**Oil for Engine.**—Neat's foot or sperm oil should be used; but if this cannot be procured, olive or castor oil will answer the purpose. Hot tallow should never be poured into the cylinder, for much dirt is thereby introduced, which will cut and injure the piston and cylinder.

"**Small Repairs.**—The parts that will require repairing most frequently are the brasses of the connecting-rod and crank-shaft; the guidebars also occasionally require adjusting; but all these things should be done by an Engineer who is accustomed to the work, and the file and chisel must never be used by the Engineman, or more harm than good will be done."

Lastly, in giving a few instructions for slight repairs we presume that the attendant is capable of using the files to a small extent; if not, for some of the repairs, such as re-fitting the brasses, it will be necessary to procure a mechanic. Should there be any leakage at any of the glands or stuffing-boxes, they may be tightened by screwing up; if, however, they have been frequently screwed up, they will require to be refilled with fresh packing, which is done by introducing into the stuffing-box a quantity of hemp or spun-yarn of the finest quality, which is plaited into a square or flat rope, capable of exactly filling the box sideways, inserting as many coils

along with tallow as will fill it nearly full, leaving as much room as will admit of the gland entering, which must be screwed up equally on each stud, avoiding all jamming. All the glands on the Engine are treated in the same manner except the gauge glass, which is packed with Indian rubber washers made expressly for the purpose; if these cannot be procured, a little cotton wick should be inserted in the same manner as the hemp; in the glands above noted, if the connecting-rod or crank-shaft brasses are loose, which may be easily ascertained from the knocking noise made by the part, it is necessary to remove the strap by withdrawing the gib and cotter and taking out the brasses, apply them to the journal to which they belong with the hand, when the exact amount of looseness or play will be ascertained, which must be taken off the butting surface to allow the brasses to come together. If the brasses are bearing on the journals throughout their whole circumference, it is advisable to ease them at the sides to the extent of one-sixth the circumference, leaving two-thirds bearing top and bottom. This being done, the brasses may be put in the places, and the cotter driven up sufficiently tight to prevent knocking and sufficiently slack to prevent heating; to do this part of repairing, however, will require an attendant having a slight knowledge of the construction of Engines.

General Remarks.—The more care and attention the Engine receives the longer it will work without extensive repairs. Very frequently great damage is done, and heavy expense incurred, through the carelessness and ignorance of the person who acts as Engineman. Wood should never, if possible, be used as a fuel when the Engine is at work near timber or thatched sheds, on account of the great quantity of ignited pieces thrown out of the top of the funnel by the steamblast. All tools and spanners must always be kept in the tool box with the Engines ready for use, and every thing should be kept in its place.

Good stoking consists, first, in preparing and selecting the coals so as to be of the proper size fitted for the purpose; and, second, supplying these coals in a regular methodical way to the interior of the furnace. First, as to the condition of the coals. These should be broken carefully in small pieces. Mr. Armstrong, a modern authority on Boiler Engineering, says :—"See that no coal is left in the heap ready for going on, bigger than a man's fist, and that the very small coal, or slack, is wetted or at least damp." As to the second point, the mode of supplying the coal to the furnace. This has been summed up in the following sentence :—Fire thinly, fire frequently, and fire regularly. Watt long ago saw the value of the thin mode of firing. "The oftener," he says, "you fire, and the thinner, the better. The fire should be kept an equal thickness, and free from open places or holes, which are extremely prejudicial, and should be filled up as soon as they appear."

Bridges.

B. B. and C. I. R.—Most of these bridges are of Warren's Girders $62\frac{1}{2}'$ long, $7\frac{3}{4}'$ deep, clear span $60'$; weight $24\frac{3}{5}$ tons per

span; cost Rs. 190 per ton; tested to 1¼ tons per foot run. Cost of screwing cast-iron piles, including erection, fitting and painting, Rs. 9 per Running foot. Cost of erecting, fitting girders, including timbers, planking and painting, Rs. 30 per ton.

Erection of Iron Girders.—The Chief Engineer, G. I. P. Railway, gives the average cost of erection of ironwork of girders of 60 feet, 80 feet and 100 feet spans at Rs. 50 per ton.

Flooring for Road Bridges.—There is no flooring for wooden bridges of any sort better than round uncut Teak "Bullies" *well seasoned* with bark, removed, placed transversely, not touching each other, the intervals filled with clean round pebbles, and over them concrete brought to the proper barrelled shape, on which is laid the gravel or metal road surface. The rafters not to be dammered. The rafters of this sort on the Sungum Bridge at Poona put down more than 20 years ago were perfectly sound when removed for the construction of the new bridge.

Wing Walls.—There is nothing destroys the appearance of a road more than having the coping of the wing walls of bridges and drains either higher or lower or not in the same plane with the slope of the bank; and yet it is a point on which Overseers are remarkably careless. Insist on the coping of the wing wall being perfectly flush in the same plane with the slope of the bank, and the junction of the road and bridge will always look well finished.

Sand Boxes.—Up to 30 feet span it is not necessary to use sand boxes, but strong double canvas sand bags answer equally well. When it is necessary to strike the centre, slit the bags with a knife, and the sand escapes as required.

Arch Quoins.—It is a common practice to make arch quoins the thickness of 2 or 3 courses of the arch sheeting, the result being that, when the arch settles, the quoins separate from the sheeting. The compiler can state that he has seen hundreds of bridges and drains in this country where this has occurred, and many cases in which the ashlar arch quoins have had to be removed, and new quoins of the same thickness as the sheeting put in. Except, therefore, in bridges where the faces of the arch are seen and an achitectural appearance is required, the quoins should invariably be of the same thickness as the sheeting. It is simply weakening the bridge at a useless expense to put ashlar quoins with fine joints to rubble sheeting.

This separation between the arch quoins and sheeting also frequently results from the difference of dressing in the beds of the sheeting and quoins, and of the thickness of joints: also to the want of *bond* between quoins and sheeting. This latter may be modified by the introduction of Hoop iron bond.

Pile Driving

Without a Pile-driving Engine. Set an iron rod 2 inches in diameter and 7 feet or 8 feet long about 1 foot into the centre of the head of each pile truly parallel to the length. Up and down

this guide rod is worked a wooden monkey about 9½ inches diameter and 3 feet long provided with 4 handles of ¾ inch iron secured by wood screws to the block under 2-inch iron rings shrunk on at either end. Down the centre of the monkey is a 2½-inch hole to allow it to slide freely up and down the guide rod. The monkey is worked up and down by men who stand on a platform fixed to the pile.

In calculating the effects of a monkey (ram) in driving a pile, an approximate value may be obtained by assuming that the impact or force of the blow (in foot-lbs.)$= \sqrt{2gh}$ where—

w = Weight of ram in lbs.
g = 32·2 feet.
h = fall of ram in feet.

Pipe Laying.

Weight and thickness per 2 yards of iron *piping*—

Diameter.	Thickness.	Weight per yard. Cwt.	qrs.	lbs.
3″	⅜″ full	0	1	16
4″	⅜″ ,,	0	2	2
5″	7/16″ ,,	0	2	23
6″	½″ bare	0	3	19
7″	½″ ,,	1	0	9
8″	½″	1	1	4
9″	9/16″	1	2	8
10″	9/16″	1	3	0
11″	9/16″ full	2	0	4
12″	⅝″ ,,	2	1	14
15″	11/16″ bare	3	0	7
18″	11/16″	3	3	9
21″	¾″	4	3	0
24″	⅞″	6	1	0
27″	1″	8	0	7
30″	1 1/16″	9	2	0
33″	1⅛″	11	0	0
36″	1⅛″	12	0	0
42″	1⅛″ full	14	1	9
48″	1¼″	18	1	0

A safe estimate of amount of lead required for laying socket pipes is ½ circumference in inches, equal to number of lbs. of lead. Pipes with turned or bored joints are, however, more used now than those with socket ends.

Cast-iron pipes, for 99 feet, or 11 pipes in 9 feet lengths 2 feet below surface.

Labour and materials.

Labourers 20.
Lead 11 × 12 lbs. = 132 lbs.
Hemp 11 × ½ ,, = 5½ ,,
Charcoal = 20 ,,

8-inch pipes.

Labourers 20.

Lead	11 ×	8½ lbs. =	93½ lbs.
Hemp	11 ×	⅓ lb. =	3⅔ „
Charcoal		=	15 „

6-inch pipes.

Labourers 20.

Lead	11 ×	7 lbs. =	77 lbs.
Hemp	11 ×	¼ lb. =	2¾ „
Charcoal		=	12 „

3-inch pipes.

Labourers 20.

Lead	11 ×	2·5 lbs. =	27½ lbs.
Hemp	11 ×	⅛ „ =	1⅝ „
Charcoal		=	8 „

Note.—Actual rates from Pandharpur Water Works.

Earthenware Pipes.—12 inches diameter 2 feet below surface 10 pipes or 20 feet in length laid with oil cement.

Labour—

Excavation	3
Laying	1½
Cement	2
	6½

Materials—

Pipes	10
Lime	20 lbs.
Oil	4 „

Present prices in Bombay.

For 2 feet lengths.

	Rs.	a.	
6 inches	1	6	each length
9 „	2	4	„
12 „	4	0	„

Solution for coating Iron Pipes, &c.

30 gallons	Coal Tar.
30 lbs.	Fresh slaked lime.
6 „	Tallow.
3 „	Lamp black.
1½ „	Resin.

Mix well, boil for twenty minutes, and lay on hot.

Pumping.

Gwynne's Centrifugal Pumps.—The following may be taken as a fair estimate of the discharge and necessary power required to drive the following sizes of pumps:—A 6-inch pump will discharge 700 gallons per minute worked by a 6-H. P. Engine.

A 7-inch, 900 gallons per minute worked by an 8-H. P. Engine. An 8-inch, 1,100 gallons per minute worked by an 10-H. P. Engine. The smaller sizes worked by hand and bullock power are not found to be effective.

Cost of filling Kaylán tank (Railway) by *steam* power is Rs. 2-10 per 9,000 gallons, or 4 annas 8 pie per 1,000 gallons; Bhándup tank by *hand* power Rs. 3 per 12,550 gallons, or 3 annas 10 pie per 1,000 gallons.

Boring.

The ordinary boring apparatus consists of a succession of iron rods from 10 feet to 20 feet in length, 1 inch square in section joined by screw threads; the boring tool is attached to the lowest rod. The screw joint Fig. 1 has the disadvantage of coming undone when from any circumstance it becomes necessary to turn the rod in the opposite direction to that in which the thread runs. Another joint which has not this disadvantage is shown in Fig. 2.

The augur Fig. 3 is similar to a carpenter's. It is used when boring in earth, clay or firm sand. The mud shell Fig. 4 consists of a cylinder of a strong sheet iron with a diaphragm across it having a hole in the centre closed by a valve opening upwards or by a ball. It will loosen and raise quicksand, mud, and earth of too loose a nature to be removed by the ordinary augur. The chisel Fig. 6 is sometimes made of the same shape as the miner's jumper or with three edges radiating from the centre as shown in Fig. 5. It is used for piercing rocks, stones, &c., in a similar manner to a miner's jumper by raising it some distance and letting it drop, gradually turning it round after each blow. The pounded rock is brought to the surface by the augur or by a long spoon. Another chisel is shown in Fig. 7.

The worm screw Fig. 8 is used for catching up and removing small stones or any other foreign matter which may have tumbled down the boring, or for raising a broken rod, &c. The tube drawer Fig. 9 is used for drawing such tubes as have to be raised or have been badly put down. The conical bell Fig. 10 is for recovering any length of boring rods which may have dropt down.

In military boring operations, when materials and timber may be scarce, it is usual to work without a scaffolding, using a triangle gyn to raise the rods and sinking a pit 6′ deep 6″ in diameter at top and 4′ at the bottom for the men who turn the rods to work in (Fig. 13). This pit having been sunk and the gyn erected with its summit directly over the intended boring, a pully 1′ in diameter, called a rigger, must be fastened to the gyn, to take the rope for elevating the boring rod. A frame 1′ square, called an augur board, having two flaps, is sunk in the bottom of the floor of the pit so as to prevent any loose stuff from tumbling down the boring. There is a hole of 2″ in diameter between the flaps for passing the boring rods through. A spar is lashed to 2 legs

Boring Tools

Fig: I Joints of Rods

Fig: II

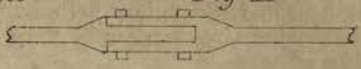


Fig: III Auger

Mud Shell Fig: IV

Fig: V

Chusels

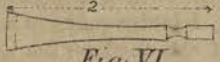


Fig: VI

Fig: VII

Fig: VIII

Rod & Tube Drawers

Fig: IX Fig: X

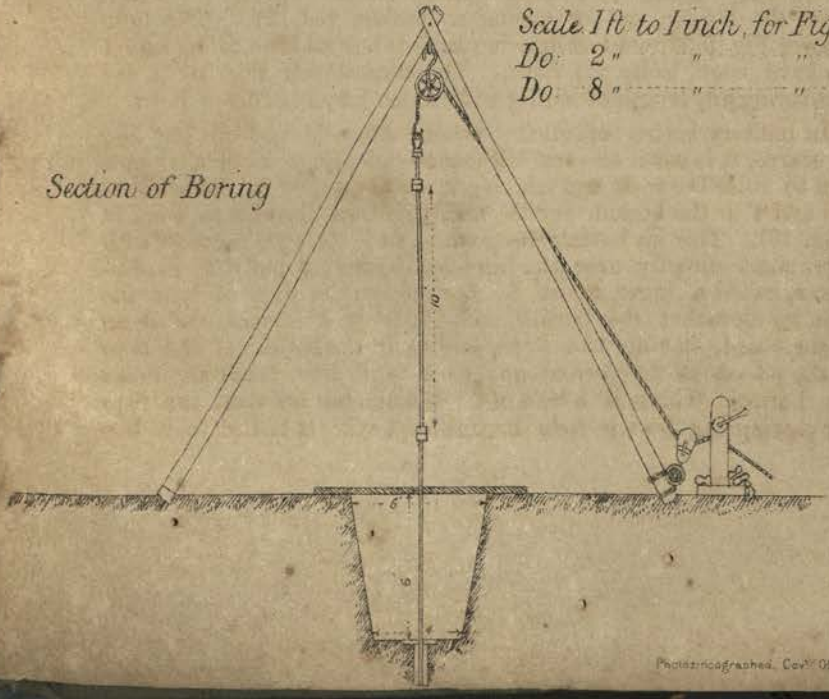
Fig: XI

Fig: XII Double Lever

Fig: XIII

Scale 1 ft to 1 inch, for Figs: I to X
Do 2" " " XI to XII
Do 8" " " XIII

Section of Boring



Photozincographed, Gov't Office, Peshawar, 1887

of the gyn close to the ground, to which a snatch-block is fastened for taking the fall to the windlass, which is placed close to the spar, and weighted down with sand bags, &c.

The fall being rove through the block, the lower end is attached to a short end (about 2′) of rod having a swivel at the top which allows the rod to turn round without twisting the rope. Next a rod is screwed on, and the fall being tightened, the rod is raised vertically into its position over the intended boring, and passed through a 3″ hole in the centre of a plank laid across the pit.

Two men descend into the pit and there attach the boring tool to be used, screwing it well home by means of the double lever shown in Fig. 12 which they afterwards use for turning the rods, shifting it up the rod as the boring progresses. The men above, cover over the pit completely with planks, and slip the four-handled lever on to the rod. The men in the pit open the flaps of the augur board, and lower the tool on to the ground, and man their double-handed lever, while the men above work their four-handed one, walking round with the sun. In this way the boring is continued, the tool being occasionally raised into the pit to clear it of earth or to change it, additional lengths of rod being added as required. If the boring is to be carried to a considerable length, a scaffolding in a deeper pit will be advantageous, to enable the rods to be unscrewed in sections equal in length to the depth of the pit, whereas with a gyn and a 6 feet pit each joint must be separated.

The chisel is worked by the men simply hauling on the rope and suddenly letting it go. If the weight becomes too great to be thus raised, it can be lifted by the windlass, the man who hauls on the fall simply slacking it when the chisel is raised sufficiently, and allowing the turns to slip round the barrel; he should only pay out enough rope to allow the chisel to fall the depth of its stroke: if too much rope be paid out, the head of the rod wabbles about, and the rods get bent.

When the strata through which the boring passes are firm, the smallness of its diameter will render needless the taking of any precautions to prevent the sides from falling in: but if the boring passes through strata of quicksand, marshy earth, &c., a casing of pipes must be provided.

The pipes generally used are of wrought-iron from 12 to 15 feet long and of successive diameters, from 3 inches upwards, so as to pass one within the other. They are provided with bayonet joints, by which they are united together. The largest pipes are first placed in the boring, successive lengths being added at the top until the required length is got in, and forced down if necessary by a monkey or small pile engine, acting on a block of elm fitting in the head of the pipe. When the resistance of the earth prevents the pipes being driven any further, one of which the exterior diameter is exactly equal to the interior diameter of the pipe already placed, is lowered down, the boring for it being

made by tools of proper diameter. Successive series of pipes are added as required, until the diameter of the hole is so much restricted as to prevent any further boring. If water be not yet met with, the only thing is to withdraw all the pipes, and commence from the top with pipes of larger diameter.

Samples of the various strata through which the boring passes should be preserved, their thickness and any other information likely to prove useful being noted.

Too great precautions cannot be taken to prevent the breaking of the boring rods, which is the most troublesome and expensive accident that can occur. When the boring rods, from their great length, become too heavy to be lifted and allowed to drop with safety, a portion of their weight may be taken by means of a counterpoise. In America the boring is generally made entirely by jumping, one length of rod only being used next the chisel, the remainder of the rod being replaced by rope.

Knotting and Splicing.

The size of rope is denoted by its circumference in inches, and its length is always given in fathoms.

When a rope is passed through a block, it is said to be *rove*; if one end is made fast, that end is called the *standing part*, the other end the *running end*, and the end of the rope to which the power is applied *the fall*.

In the plates the points of the running ends are shown *whipped*, and the direction in which the power is applied is denoted by an arrow.

In uncoiling a new coil of rope, pass the end which is at the core through the core to the opposite side, and draw it out, when the turns will run out without kinking.

Thumb or Overhand Knot.—Grasping the end of the rope with the right hand, and the standing part in the left, pass the end of the rope over the standing part up through the bight thus formed; haul taut, and the knot is complete. This is the simplest kind of knot, and is used to prevent ropes running through blocks when rove, &c. (Fig. 2).

Figure of 8 Knot.—Holding the rope, as in the last paragraph, pass the end of the rope under, round and over the standing part, then upwards through the bight thus formed. This knot is used for much the same purpose as the last. (Fig. 3.)

Reef Knot.—Holding one end in each hand, ends to the front, lay the ends of the two ropes to be joined across one another, the left hand rope over the right, and take it once completely round that held in the right hand. Turn the original left hand end back in the direction of and alongside its standing part, and take the original right hand end over the double, up through the loop, and haul taut. The standing and running parts of each rope must pass through the loop of the other part in the same

Knots &c:

Plate XXVIII.

Fig: I. Coiling a Rope

Fig: II. Thumb

Fig: III. Figure of 8

Fig: IV. Reef

Fig: V. Granny

Fig: VI. Draw

Fig: VII. Single Sheet Bend

Fig: VIII. Round Turn and Two Half Hitches

Fig: IX. Rolling Bend.

Fig: X. Fisherman's Bend

Fig: XI. Double Sheet Bend.

Fig: XII.

Fig: XIII.

Fig: XIV.

Fig: XV. Sheep Shank

Clove Hitch

Fig: XVI. Commencement of Bowline

Fig: XVII. Bowline

Fig: XVIII. Running Bowline

Fig: XIX. Bowline on a Bight

Fig: XX. Timber Hitch

Fig XXI. Carrick Bend.

Photozincographed, Court Office Rooms, 1882.

direction (Fig. 4): if they pass in the opposite direction, as in Fig. 5, the knot is what is termed a granny, and cannot be undone when tightened up with the same ease that a reef knot can. A reef knot can be upset, and the ends pulled out, by taking one end of the rope and its standing part, and pulling them in opposite directions.

Draw Knot.—This knot is the same as a reef knot, with the exception that a double of the original left hand end is laid alongside its own standing part, thus forming a loop, and the right hand end is taken over the double, and the loop formed by the double as in the above knot. (Fig. 6.)

Single Sheet Bend.—Take a bight or double at the end of one rope, holding it in the left hand, and pass the end of the other rope held in the right hand up through the bight, down on one side under and up over the bight and under its own standing end (Fig. 7). It is used for joining two anchor cables together.

Double Sheet Bend—When greater security is required, *a double sheet bend* is used, in which the running end is passed twice round the bight and under its own standing end each time. (Fig. 11.)

Two Half Hitches.—With the end of the rope in the right hand, and the standing part in the left, pass the end of the rope round its standing part, and up through the bight, thus forming one half hitch; two of these alongside of one another complete the knot; in Fig. 8 this knot is represented on the standing part of rope passed round, and made fast to a spar, but it should never be used for hoisting a spar. The end may be lashed down to the standing part by a piece of spun yarn, which adds to its security, and prevents the end from slipping.

Round Turn and Two Half Hitches.—This knot is the same as the last, with the exception that a complete turn is taken round the spar or other object to which the rope is to be fastened, and the half hitches taken afterwards round the standing part (Fig. 9); this knot is sometimes called *a rolling bend.*

Fisherman's Bend.—Two complete turns are taken round the spar or other object to which the rope is to be fastened, and the end passed over the standing part, through the two turns next the spar over its own part, thus forming one-half hitch, and the second half hitch taken round the standing part alone. It is used in pontooning, to fasten the cables to the rings of the anchors (Fig. 10).

Sheep Shank.—This knot is used for shortening a rope, the ends of which are made fast; the rope is laid up in 3 parts (Fig. 15) and a hitch taken over each bight with the standing and running parts, respectively, of the rope, and jammed taut.

Clove Hitch.—When it is desired to secure a rope to the end of a spar, this knot can be made first, and the loop so formed passed over the end of the spar.

To make this knot, make two loops with the running end of the rope (Fig. 12); place the last made loop over the other one (Fig. 13), and slip the double loop so formed over the end of the spar, &c. (Fig. 14.)

When a rope has to be secured to a spar, over the end of which the knot cannot be slipped, pass the end over and round the spar, bring it up to the left of the standing part, and again down and round the spar, to the right of the first turn, and bring the end up between the spar the last turn, and the standing part (Fig. 14). When used in lashing spars, the end should be twisted round the standing part as in the figure. As this knot is one of the most useful and most frequently required, men should be practised in making it in various positions.

Bowline.—Holding the standing part of the rope in the left hand, with the right hand lay the end over the standing part pointing to the left; keeping the end in place with the right hand, make a loop with the standing part over the end, pass the end under the standing part, and finally down through the loop, previously made, and haul taut the end and the double of the knot together (Figs. 16, 17).

Bowline on a Bight.—Fig. 19 illustrates this knot. Double the rope, and lay the loop held in the right hand over the two ends held in the left hand; with the left hand make a loop over the doubled end, and opening out the doubled end, bring it upwards over the whole of the knot, and haul the double taut (Fig. 19).

Timber Hitch.—Pass the end of the rope over and round the spar, &c., and round its own standing part close to the spar. Then twist it two or three times back round itself, and haul the fall taut, thus jamming the twisted end against the spar. This knot can be easily undone when the strain is taken off the fall, and is found to be really secure for lifting spars, &c., as when well made it will not slip (Fig. 20).

Carrick Bend.—A Carrick Bend is used for joining two cables or two ropes to make 4 guys for the head of a spar. Holding one of the cables to be joined in the left hand make a loop on the end of it, passing the end under the standing part away from the persons making the knot. With the right hand pass the end of the other cable across the loop under the other end over the other standing part, up through the original loop over its own standing part, and finally down through the loop and haul taut. If either of the cables (Fig. 21) be traced, it will be seen that it passes alternately over and under each rope that it crosses.

Cat's Paw.—Lay the end over the standing part of a rope, thus forming a bight, and secure the two parts together by a bit of seizing; then lay hold of the bight with one hand on each side, twisting the hands inwards in opposite directions two or three times: clap the two bights together, and hook on the tackle, &c., as required. This knot may be used as a pair of slings for shipping casks, &c. (Fig. 22).

Knots and Tackles

Fig. XXII

Cat's Paw

Fig. XXIII

Stopper Hitch

Fig. XXIV

Slip Knot

Fig. XXV

Commencing a Short Splice

Fig. XXVI

Fig. XXVII

Fig. XXVIII

Eye Splice

Fig. XXIX

Fig. XXX

Wall Knot

Fig. XXXI

Crowning & Wall Knot

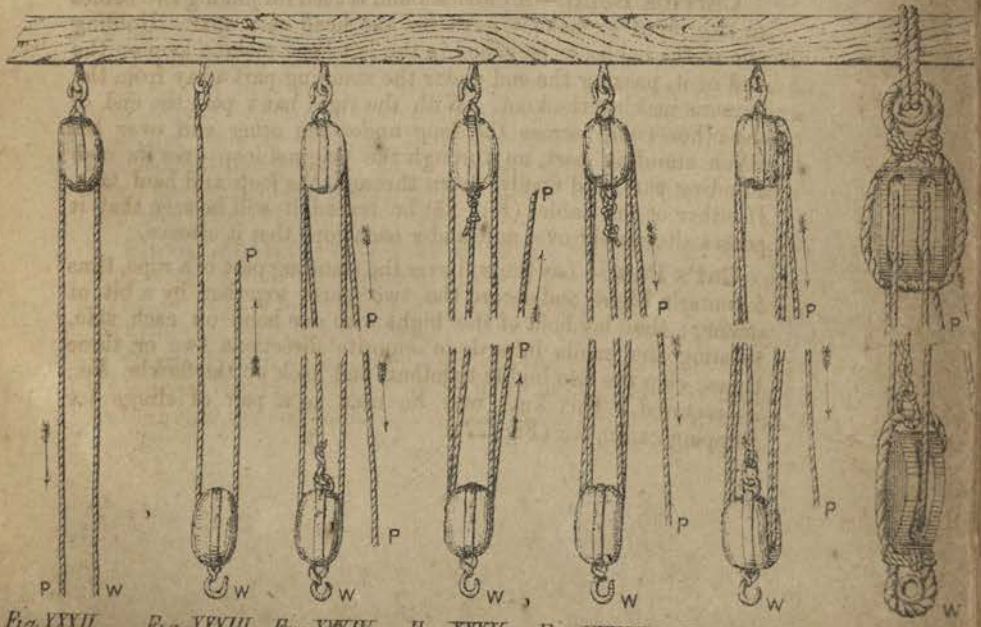


Fig. XXXII Fig. XXXIII Fig. XXXIV Fig. XXXV Fig. XXXVI Fig. XXXVII Fig. XXXVIII

Stopper Hitch.—Take one turn round with the stopper round the rope to be stoppered, and then a second over-riding the turn previously made, in the direction in which the power is applied, and bring the end over its own standing part and fasten off with two half hitches round the cable, on the opposite side of the standing part of the stopper to that on which the round turns were taken (Fig. 23).

Slip Knot or Hangman's Knot.—Take a bight on the end of a rope, and grasp it in the left hand, the bight towards the right. With the end take 4 round turns round the double of the bight, working from left to right, and pass the end through these 4 turns next to the standing part, and haul taut (Fig. 24).

Wall Knot.—This knot is a neat way of fastening off a rope to prevent its unstanding. Unlay the end of the rope (Fig. 29), and hold it with left hand end upwards. Lay the end of the nearest strand, *a*, across the front of the rope end to the right, so as to form a loop to the left. Bring the next strand on the right over and round the end of *a* to the rear of the rope, forming a loop with its end to the left; similarly pass the end of the third strand over the end of "*b*", and round it to the front through the loop in *a*, haul taut each strand and the knot will appear as in (Fig. 30).

To crown this knot, take the end of the front strand, *a*, pass it over the head of the knot, and down the rear of the rope between the other two strands, leaving a loop at the top of the knot to the front (Fig. 31). Take the next strand to the right *b*, and pass it round the rear of the loop *a*, and over the knot, between the loop and the 3rd strand *c*, and down the front of the rope. Pass the third strand *c* over *b*, where it crosses the loop at the head of the knot, and through the loop in *a*, and haul taut.

Blocks.—For the purpose of changing the directions of ropes, gaining power, &c., blocks are used. They are usually made of wood and are called single, double or treble, according to the number of sheaves contained, which being made of metal or hard wood, revolve with but slight friction on a central pin. The block is surrounded by a strop of rope or iron, by means of which it can be lashed or made fast as required; the sizes of blocks are designative by their length usually expressed in inches.

Tackles.—Figs. 22 to 38 show the various combinations of blocks most commonly used for forming tackles with falls rove ready for use where W is the weight to be moved and P the power applied.

Fig. 32 a single moveable block, which gives no increase of power, but merely a change of direction. It is often called a whip, and for this purpose a snatch block (*i.e*, a block with a moveable strop to admit a rope without the necessity of passing its end through the block) is often used.

Fig. 33 a single moveable block, when $W = 2\ P$.

Fig. 34 a gun tackle consisting of a fixed double and moveable single block where $W = 3\ P$.

Fig. 35 with a fixed single and moveable double when $W = 4\,P$.

Fig. 36 a luff tackle with 2 double blocks, the standing ends being attached to the fixed block when $W = 4\,P$.

Fig. 37 a gyn tackle with a fixed treble and a moveable double block where $W = 5\,P$.

Fig. 38 a gun tackle of large blocks with thimbles fitted instead of hooks.

The standing end of the rope is never fixed to the block with the greater number of sheaves; the weight any system of 2 blocks will lift is formed by multiplying the power by the number of ropes at the moveable block including the standing end if fixed to it. The strops of blocks must be strong enough to withstand the greatest strain, which is equal to the power multiplied by the greatest number of ropes at either block.

To form a pair of Temporary Sheers.—The two spars for the sheers of equal length are laid alongside each other with their butts together on the ground, the parts below where the lashing is to be, resting on a short spar. A clove hitch is then made round one spar and the lashing taken loosely 8 or 9 times round the two spars above it without riding. A couple of frapping turns are then taken between the spars round the lashing, and finished off with a clove hitch above the round turns on the other spar. It will then appear as in Fig. 1.

The butts of the spars are then opened out, and a sling passed over the fork of the spars to which the block is hooked or lashed. Fore and back guys are then made fast with clove hitches to the tips of the spars, so arranged as to draw their heads together; when the strain comes on them foot ropes are secured to the butts of the spars by pickets, and the sheers are ready for raising (Fig. 2).

To form a Gyn or Tripod Trestle.—The distance from the butts at which the centre of the lashing is to be is marked on each spar. Two of the spars are then laid parallel to each other, rather farther apart than their own diameter, with their tips resting on piece of skidding, and the 3rd spar is laid between them, with its butt in the opposite direction, so that the marks on the 3 spars may be in line. A clove hitch is then made on one spar, and the lashing taken over and under the spars loosely 8 or 9 times; the lashing will then appear as in Fig. 3. A couple of frapping turns are then taken between each pair of spars in succession round the lashing, and finished off with a clove hitch in one of the spars; the lashing will then appear as in Fig. 4. A sting is then passed over the lashing and the gyn is ready for raising.

To lash a Transom to an upright Spar (see Figs. 5, 6 and 7).—In the description the transom is supposed to be in front of the upright. A clove hitch is made round the upright below the position of the transom, the lashing brought under the transom, up in front of it, horizontally behind the upright, down in front of the transom and back behind the upright, below the clove hitch,

Lashings of Spars

Fig I

Fig: II

Fig III

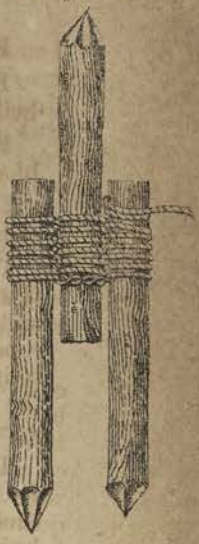
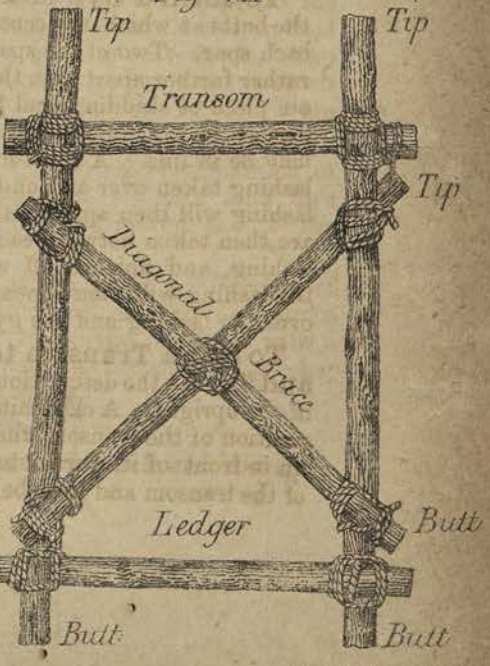


Fig: V

Fig: VI

Fig: IV

Fig: VII



Photozincographed, Govt Office, Poona, 1882

and so on following round, keeping outside of, and not riding over the turns already made. Six turns or more will be required. A couple of frapping turns are then taken between the spars round the lashing, binding the whole firmly together, and the lashing is finished off with clove hitch either round one of the spars or any part of the lashing through which the rope can be passed. The lashing must be well beaten with a handspike or pick handle, to tighten it up.

Miscellaneous Notes.

Average price per cubic foot of the different descriptions of buildings erected by the War Department.—Amount arrived at by taking the outside dimensions above foundations for length and breadth. Height ½ way up roof and ½ depth of foundations including footings and concrete.

	d.
Officers' Quarters	8½
Soldiers' Barracks	6
Married Soldiers' Quarters	6½
Stables with Quarters over	5
Stables	9
Chapel School	4½
Recreation Rooms	4¼
Gun Sheds	3½
Gymnasia	2½

The cost per cubic foot of the principal Government buildings erected by the Public Works Department in Bombay has been as below. The measurements being taken as follows :—Height—from the ground line to half way up the length and breadth—the exterior dimensions of superstructure ; Verandahs taken as solid.

	Rate per cubic foot. Annas.
Elphinstone College	10.
Mechanics' Institute	11.
Eye Hospital	5·66
Incurable Hospital	6·83
New Secretariat	7·33
Public Works Offices	7·25
University Hall	9·50
,, Library	9·83
Clock Tower	15·66
Native General Hospital	5·83
New Post Office	5·92
New High Court	5·00
Telegraph Office	4·92
Sailors' Home	4·58
New High School	4·66
School of Art	4·25

Size of Racquet Courts.—The small court at Prince's, 60′ × 30′ × 30′ high; R. M. Academy, Woolwich, 64′ × 32′; Byculla Club, 75′ × 36′; Kirkee, 73′ × 34½′; Poona, 72′ × 34′.

Temporarily Restoring Drawing Paper.—From *Bombay Builder*, 1865. The quantity given is sufficient for a sheet of Antiquarian.

Isinglass 6 grains, alum 2 grains, water 3 fluid ozs. Soak the isinglass for an hour or two to soften the threads in 2 ozs. of water; add the 3rd oz. and simmer gently till the isinglass is dissolved. Then add the 2 grs. of alum in powder or dissolved in a small quantity of water; stir thoroughly and strain through fine muslin. The paper should be mounted and brushed over while damp with the solution applied by a broad flat brush. When quite dry it should be sponged with a liberal supply of water to float off loose patches of size. If the paper shows spots on being wetted, the operation should be repeated; twice is sufficient generally even in a bad case.

Size of Drawing Paper.

Demy	20″ × 15″
Medium	22½″ × 17″
Royal	24″ × 19½″
Super Royal	27″ × 19½″
Imperial	30″ × 22″
Columbian...	34″ × 23″
Double Elephant	40″ × 27″
Antiquarian	53″ × 31″
Extra ,, ...	56″ × 38″

China and Glass Cement.—Equal parts, by weight, of beeswax, sulphur and rosin; melt wax on sand bath, and rosin powdered, and then sulphur till sublimed; then apply to broken pieces also heated on sand bath.

To purify Water for drinking.—Add to the water to be purified a few drops of permanganate of potash (costs about Rs. 1 per ½ oz). If the pink colour disappears, there is organic matter present, and the permanganate should be added until the pink colour is permanent. It is best to test a small quantity of water first, and then to add as much as necessary to the day's supply.

The water can afterwards be filtered through clean sand and charcoal with advantage. Permanganate of potash destroys organic matter already in a state of putrefaction instantaneously; but it takes half an hour or more to destroy matter about to putrefy.

Alum, *i.e.*, sulphate of alumina, is highly valuable as a purifying agent. It attaches itself to organic animal matter, living germs, &c., and converts them into an insoluble substance like leather. It may be used independently or in combination with permanganate of potash.

Cleaning Saddlery or Leather Work.—Beeswax 6 ozs., resin 3 ozs., linseed oil ¼ pint, mix and stir together in saucepan; take off fire, add 1 pint neat's foot oil, ½ pint turpentine, and 1 oz. camphor, and pot for use.

Leather Preservative or Emollient.—Castor oil is the best known. It does not prevent polish from blacking, and it is said that leather so treated will not be attacked by rats or mice.

Metal Screws or Bottle Stoppers.—To remove apply plentifully spirits of turpentine; this will loosen screws or stoppers almost immediately.

To harden Steel.—The article to be made white hot and then thrust into sealing-wax (common lac), withdrawn, and then insert again in another part, and so on till cold.

Alloy that expands in cooling:—

9 parts lead.
2 antimony.
1 bismuth.

Wooden Labels, to preserve.—Soak in a strong solution of sulphate of iron; when dry place them in lime water. This causes formation of sulphate of lime and will last for years.

Zinc, to write on.—Use solution of sulphate of copper (blue vitriol) with a quill pen.

Waterproof Mixture.—For under water blasting—

Tallow	5 per cent.
Rosin	15 „
Gutta percha	20 „
Pitch	60 „

Fumigation.—Adopt one of the following processes:—

With chlorine gas.

(*a*).	Take common salt	4 ozs.
	„ oxide of manganese (in powder) ...	1 „
	„ sulphuric acid	1 „
	„ water	2 „

The water and acid to be mixed together and then poured over the ingredients in a delf basin, which should be placed in a pipkin of hot sand.

With nitric oxide gas.

(*b*).	Take copper shavings	½ oz.
	„ nitric acid	1½ „
	„ water	1½ „

Pour the acid and water upon the copper in a small jar.

(*c*). With sulphurous acid gas.

Burn 2 ozs. of sulphur in a pipkin.

All doors and windows to be closed before commencing fumigation.

The operator will leave the room immediately the process is commenced.

At the expiration of from 2 to 3 hours all doors and windows will be thrown open to free ventilation.

Rooms to be completely emptied before fumigation is commenced.

To render Glass Opaque or Frosted.—Clean the sheet of glass; and if only portions of it are to be frosted, protect the portions not to be frosted by mechanical means in any simple manner.

Some fluor spar is ground to a fine powder and mixed with concentrated sulphuric acid so as to form a thin paste, and this is rubbed by means of a piece of lead upon the parts to be rendered opaque. This process is known as "Etching on glass" by "hydrofluoric acid".

Gently heat the glass, when noxious fumes will be given off. On cooling, the plate is washed with dilute solution of soda and potash to remove any acid yet remaining, and is then rinsed in water.

Care should be taken that the fluoric acid does not get on the skin.

White Ant Lotions:—

		Lbs.	ozs.
1 *Arsenical.*—Arsenic	...	2	4
Dhobi's mud khar	...	2	8
Soap, country ...	...	2	13
Aloes (Ærea) ...	...	2	4
Water	...	4 gallons.	

Pound ingredients fine, mix, boil in half the water in earthen or iron vessel. Let it cool, then add the rest of the water and boil again. Cost about Rs. 1-5-3 per gallon. Does not stand exposure to rain, being more for inside work. Wood, if possible, to be steeped; but if applied, a solution will answer.

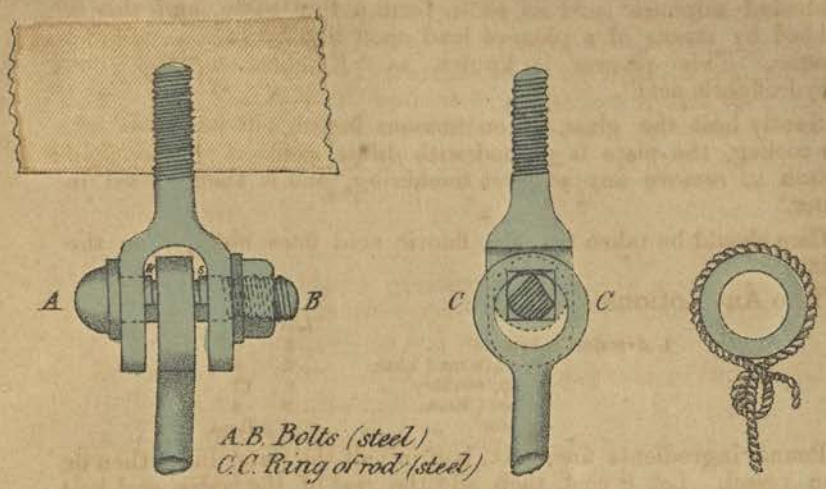
2. *Copper Sulphate*—(blue stones or moorchood) 1 lb. dissolved in 4 gallons of water (costs 4 annas per gallon), takes two days steeping per inch of wood.

3. McDougal's sheep dipping composition 1 lb. to 5 gallons; costs about 2 annas per gallon.

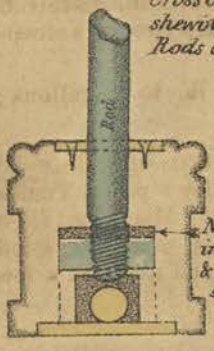
Varnish for Name-Boards, Labels, &c.—Sandrac 53 parts, mastic 20 parts, camphor 1 part, oil of lavender 8 parts, Venice turpentine 4 parts, Ether 6 parts, alcohol 40 parts. Macerate for a week or two until the whole is dissolved. This makes a good varnish, with colourless smooth and shining coat, and dries in a few minutes.

Method of Hanging Punkhas

Plate XXXIV.



A.B. Bolts (steel)
C.C. Ring of rod (steel)



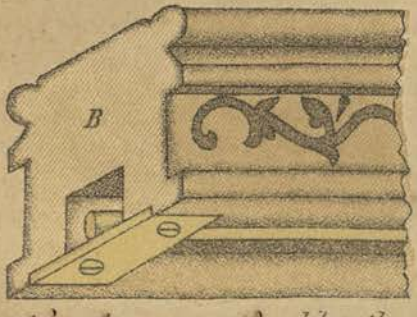
Cross Section of Punkha Bar shewing method of connecting Rods or hooks to receive ropes.

A.B.C.D. Square in Section

O.P. Purposely sunk to keep ring of rod or ring from contact of edges R.S

Section

Ring for Rope Suspender



The brass rod may be in one or several lengths arranged to coincide with brass plates Carved or turned bosses. plugged screwed at end of bar to keep rod or rods in position. Blackwood inlaid or not according to requirement.

Carved boss, plugged, screwed, to cover the end B

Govt Photozincographic Office, Poona 1883

XII.—APPENDIX.

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XII.—APPENDIX.

Description of the Tables.

The following two series of Tables are intended to facilitate the calculation of earth-work in cuttings and embankments in the preparation of projects for roads and canals. They are based on the prismoidal formula, and the results obtained therefrom will be, therefore, absolutely correct. It is impossible, of course, to furnish Tables which shall include all widths of formation, side slopes, or even all possible heights of section. To limit, therefore, the number of such, only certain side slopes frequently adopted in practice, *viz.*, ½ to 1, 1 to 1, 1½ to 1, and 2 to 1, have been provided for; to any other than these the following tables would not apply at all.

Next, in regard to the limit assigned to widths of formation and for which the prismoidal mean area has been duly calculated and tabulated, it will be noted that the bases adopted are 20, 22, 24 and 26 feet. These have been selected as being probably more useful than any other. Each of these bases have been calculated to each of the side slopes stated above, and to sections the height of which at either end does not exceed 20 feet. This series of Tables is numbered from I to XVI.

For widths of formation other than the above, or for heights of section over 20 feet (but under 40 feet) at either end, recourse must be had to the series of Tables numbered from XVII to XLVIII, from which the prismoidal mean area for *any* base and for *any* height may be calculated in the way shown below. In the practical application of this second series of Tables two multiplications will be needed, instead of one only as in the first series, in order to determine the cubical content of a given length of cutting or embankment. First the prismoidal mean area has to be ascertained, and this then multiplied by the length of such section in *feet*; the result arrived at will be in *cubic yards*.

This second series of Tables from XVII to XLVIII is, it may be stated, a mere reprint of a portion of the "Tables for facilitating the calculation of earth-work" published by Sir John MacNeill, and the results obtained therefrom are, as is well known, in *cubic yards*. The first series of Tables from I to XVI, which are for the specific bases and side slopes above stated, have been calculated entirely from Sir John MacNeill's work by the present compiler. In order to conform, however, to the practice in force in the Public Works Department of calculating the volumes of earth-work in *cubic feet*, and also to save labour, the tabular numbers given in these Tables, or in other words the prismoidal mean areas are given in *square feet*. These, when multiplied by the length of the section also in feet, will, of course, give the result in *cubic feet*. It is necessary to bear this carefully in mind when using these Tables.

Exemplification of the use of Tables I to XVI.

Suppose *a, b, c, d, e, f, g* (Fig. 1, Plate XXXV) to represent the surface of the ground, and *h, k*, the formation level of a road passing through it in cutting, and let the cross section of such road be as represented in Fig. 2, having a width at formation level of 24 feet with side slopes of 1½ to 1. The prismoidal mean areas of the different sections A, B, C, D, &c., will be found in Table XI, and the cubical contents *in feet* of each of these sections may be found and tabulated in the following manner :—

	Heights of Sections at each end.		Tabular Number.	Length of Section in feet.	Volume in Cubic Feet.
Section A	10	15	537·5	50	26,875
„ B	15	20	882·5	25	22,062·5
„ C	20	18	998·0	100	99,800
„ D	18	14	769·9	75	57,742·5
„ E	14	12	566·0	50	28,300
„ F	12	7	366·5	100	36,650
Total Cubic-*Feet* Cutting ...					271,430

Exemplification of the use of Tables XVII to XLVIII.

Let *a, b, c, d, e, f, g,* (Fig. 3, Plate XXXV) represent the longitudinal section along the centre of a road, and *h, k* the formation level of its embanked surface, and let the cross section of such road be as represented in Fig. 4, having a width at formation level of 18 feet with side slopes of 2 to 1. As this given base (18 feet) is not one of those of which the prismoidal mean area has been calculated in the first series of Tables, recourse must be had to the second series, and it will be seen that such may readily be determined from Tables XLI to XLVIII, which have reference to a side slope of 2 to 1 as in the present instance. The prismoidal mean area of each of the sections A, B, C, D, &c., being ascertained as shown below, each should be multiplied by the length of the section *in feet*, and the results obtained will be the volumes *in cubic yards* of each section :—

Sections of Ground.

Fig. I. (Cutting)

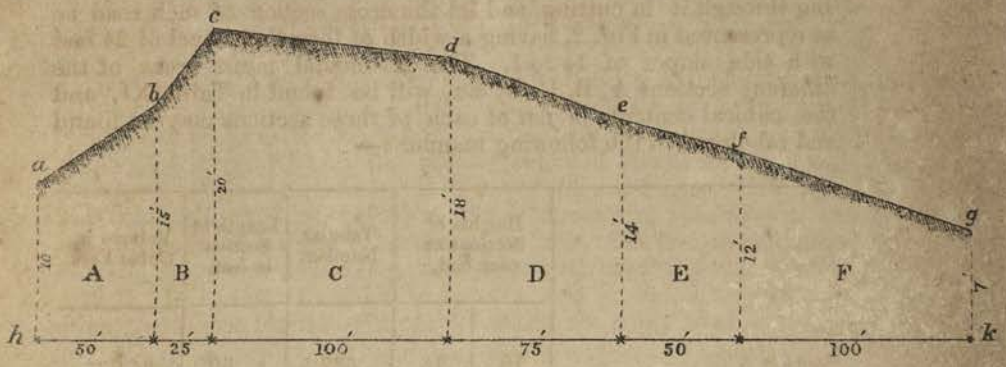


Fig. II.

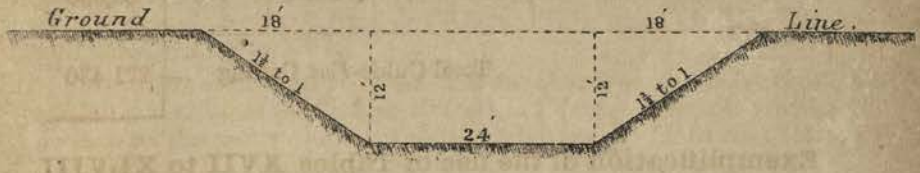


Fig. III. (Embankment)

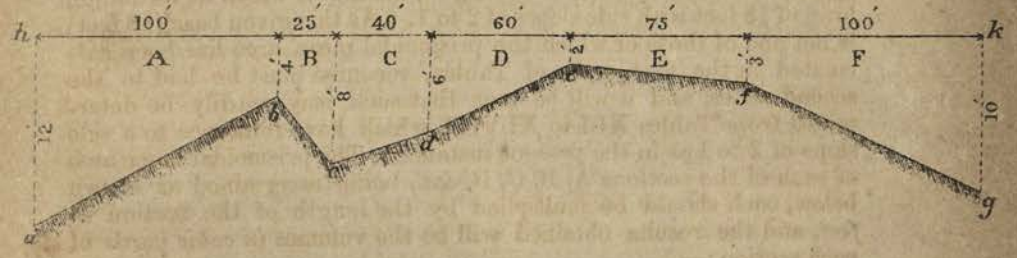
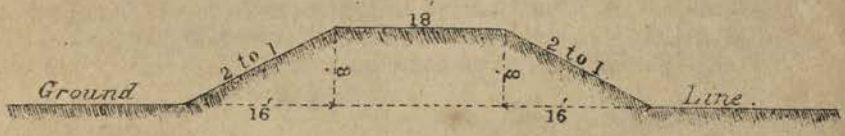


Fig. IV.



Photozincographed, Govt. Office, Poona, 1882.

	Heights of Sections at each end.		Tabular Number for Slope 2 to 1 from Tables. Mult.	Add.	Prismoidal Mean Area.	Length of Section in Feet.	Volume in Cubic-yards.	Remarks.
Section A ...	12	4	·2963	5·136	10·4694	100	1,046·94	To find prismoidal mean area multiply the number in column under "Mult" by the given base, and added thereto quantity shown in column "Add" thus :—
,, B ...	4	8	·2222	2·765	6·7646	25	169·11	
,, C ...	8	6	·2593	3·654	8·3214	40	332·85	
,, D ...	6	2	·1481	1·284	3·9428	60	236·98	
,, E ...	2	3	·0926	0·469	2·1358	75	160·18	
,, F ...	3	10	·2407	3·432	7·7646	100	776·46	·2963 × 18 + 5·136 = 10·4694 ·2222 × 18 + 2·765 = 6·7646 ·2593 × 18 + 3·654 = 8·3214 &c., &c., &c.
Total Cubic *Yards* Embankment ...							2,722·52	

Description of Tables XLIX to LII.

In order to take out the quantity of masonry work in a bridge or culvert having segmental arches a simple though laborious calculation is needed to ascertain (1) the area of the arch-ring, and (2) that of the segment of the circle formed by the intrados of the arch and the springing line. This latter area, multiplied, of course, by the thickness of the spandrel walls, has to be deducted before the contents of the spandrel walls can be accurately determined.

It will be clear then that a vast amount of labour would be saved if in those cases in which the arch-ring was of a prescribed thickness and its rise bore some well defined ratio to the span the two areas above alluded to were determined and expressed in terms *of the span itself.*

This has been done in Table XLIX. An examination of this Table will show how that for the ordinarily adopted rises of one-third, one-fourth, one-fifth, one-sixth, and one-seventh of span, and for thickness of arch-ring from 6 inches to 3 feet, the radius of the circle, the area of the segment, and that of the arch-ring itself have all been expressed in terms of the *span alone.* The example given at the foot of this Table will still further illustrate its use, and the saving effected in labour over the ordinary method in arriving at these same results.

Tables L, LI, and LII are based, of course, on Table XLIX, and give *at sight* the above information for certain useful spans from 5 to 45 feet, when the rise of the arch bears one or other of the ordinarily adopted ratios above named, and is of some corresponding suitable thickness.

These Tables from XLIX to LII will therefore in their own way, though perhaps not quite to the same extent, facilitate the preparation of estimates for bridges and culverts as those from I to XLVIII do that of the earth-work in Road or Canal projects.

TABLE I.—BASE 20.—SLOPES ½ to 1.

Feet.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Feet.
0	10·15	20·65	31·54	42·69	54·16	65·99	78·14	90·64	103·5	116·7	130·2	144·0	158·1	172·7	187·5	202·7	218·2	234·0	250·2	266·7	0
1	20·49	31·18	42·17	53·51	65·18	77·14	89·48	102·2	115·2	128·5	142·1	156·1	170·5	185·2	200·2	215·5	231·1	247·2	263·5	280·2	1
2	31·18	42·01	53·16	64·66	76·49	88·64	101·2	114·0	127·2	140·6	154·5	168·7	183·2	198·0	213·2	228·6	244·5	260·7	277·2	294·0	2
3	42·17	53·16	64·50	76·14	88·13	100·5	113·2	125·2	139·5	153·1	167·2	181·5	196·2	211·2	226·5	242·2	258·3	274·5	291·2	308·1	3
4	53·51	64·66	76·14	87·97	100·2	112·7	125·5	138·6	152·1	166·0	180·2	194·7	209·5	224·6	240·2	256·0	272·2	288·6	305·5	322·6	4
5	65·18	76·49	88·13	100·2	112·5	125·2	138·1	151·5	165·2	179·2	193·5	208·2	223·1	238·5	254·2	270·2	286·5	303·1	320·1	337·5	5
6	77·14	88·64	100·5	112·7	125·2	138·0	151·1	164·7	178·5	192·7	207·2	222·0	237·2	252·7	268·5	284·7	301·1	318·0	335·2	352·7	6
7	89·48	101·2	113·2	125·5	138·1	151·1	164·5	178·2	192·1	206·5	221·1	236·2	251·5	267·2	283·2	299·5	316·1	333·2	350·5	368·2	7
8	102·2	114·0	126·2	138·6	151·5	164·7	178·2	192·0	206·2	220·6	235·5	250·7	266·2	282·0	298·2	314·6	331·5	348·7	366·2	384·0	8
9	115·2	127·2	139·5	152·1	165·2	178·5	192·1	206·2	220·5	235·2	250·2	265·5	281·1	297·2	313·5	330·2	347·2	364·5	382·1	400·1	9
10	128·5	140·6	153·1	166·0	179·2	192·7	206·5	220·6	235·2	250·0	265·2	280·7	296·5	312·6	329·2	346·0	363·2	380·6	398·5	416·7	10
11	142·1	154·5	167·2	180·2	193·5	207·2	221·1	235·5	250·2	265·2	280·5	296·2	312·1	328·5	345·2	362·2	379·5	397·1	415·2	433·5	11
12	156·1	168·7	181·5	194·7	208·2	222·0	236·2	250·7	265·5	280·7	296·2	312·0	328·2	344·7	361·5	378·6	396·1	414·0	432·2	450·7	12
13	170·5	183·2	196·2	209·5	223·1	237·2	251·5	266·2	281·1	296·5	312·1	328·2	344·5	361·2	378·2	395·5	413·2	431·2	449·5	468·1	13
14	185·2	198·0	211·2	224·6	238·5	252·7	267·2	282·0	297·2	312·6	328·5	344·7	361·2	378·0	395·1	412·7	430·5	448·6	467·2	486·0	14
15	200·2	213·2	226·5	240.2	254·2	268·5	283·2	298·2	313·5	329·2	345·2	361·5	378·2	395·1	412·5	430·2	448·2	466·5	485·2	504·1	15
16	215·5	228·6	242·2	256·0	270·2	284·7	299·5	314·6	330·2	346·0	362·2	378·6	395·5	412·7	430·2	448·0	466·1	484·6	503·5	522·7	16
17	231·1	244·5	258·2	272·2	286·5	301·1	316·1	331·5	347·2	363·2	379·5	396·1	413·2	430·5	448·2	466·1	484·5	503·1	522·2	541·5	17
18	247·2	260·7	274·5	288·6	303·1	318·0	333·2	348·7	364·5	380·6	397·1	414·0	431·2	448·6	466·5	484·6	503·1	522·0	541·2	560·6	18
19	263·5	277·2	291·2	305·5	320·1	335·2	350·5	366·2	382·1	398·5	415·2	432·2	449·5	467·1	485·2	503·5	522·2	541·2	560·5	580·1	19
20	280·2	294·0	308·1	322·6	337·5	352·7	368·2	384·0	400·1	416·7	433·5	450·7	468·1	486·0	504·1	522·7	541·5	560·6	580·1	600·0	20

TABLE II.—BASE 20.—SLOPES 1 to 1.

Feet.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Feet.
0	10·26	21·33	32·94	45·36	58·32	72·09	86·40	101·2	116·9	133·4	150·4	167·9	186·3	205·5	224·9	245·4	266·2	288·1	310·2	333·4	0
1	21·06	32·40	44·28	56·97	70·47	84·24	99·09	114·5	130·4	146·9	164·4	182·2	200·9	220·3	240·3	261·1	282·4	304·3	327·0	350·4	1
2	32·40	44·01	56·43	69·39	82·89	97·47	112·3	128·0	144·4	161·5	179·0	197·4	216·3	236·0	256·2	277·3	299·0	321·3	344·2	368·0	2
3	44·28	56·43	69·12	82·35	96·39	111·0	126·4	142·3	159·0	176·3	194·4	213·0	232·5	252·4	273·0	294·3	316·4	339·1	362·3	386·4	3
4	56·97	69·39	82·35	96·12	110·4	125·3	140·9	157·4	174·4	192·0	210·3	229·2	248·9	269·5	290·2	312·1	334·3	357·2	381·0	405·3	4
5	70·47	82·89	96·39	110·4	125·0	140·4	156·3	173·1	190·3	208·4	227·1	246·2	266·2	287·0	308·3	330·2	352·9	376·4	400·4	425·0	5
6	84·24	97·47	111·0	125·3	140·4	156·1	172·3	189·3	207·1	225·4	244·3	264·1	284·3	305·4	327·0	349·4	372·3	396·1	420·4	445·2	6
7	99·09	112·3	126·4	140·9	156·3	172·3	189·0	206·3	224·4	243·0	262·4	282·4	302·9	324·3	346·4	369·1	392·3	416·3	440·9	466·3	7
8	114·5	128·0	142·3	157·4	173·1	189·3	206·3	224·1	242·5	261·4	281·1	301·3	322·4	344·0	366·4	389·3	413·1	437·4	462·2	487·9	8
9	130·4	144·4	159·0	174·4	190·3	207·1	224·4	242·5	261·1	280·3	300·2	321·0	342·4	364·2	386·9	410·4	434·4	459·0	484·4	510·3	9
0	146·9	161·5	176·3	192·0	208·4	225·4	243·0	261·4	280·3	300·0	320·2	341·3	362·9	385·3	408·2	432·0	456·3	481·4	507·1	533·2	10
11	164·4	179·0	194·4	210·3	227·1	244·3	262·4	281·1	300·2	320·2	341·0	362·3	384·2	406·9	430·4	454·4	479·0	504·4	530·3	557·0	11
12	182·2	197·4	213·0	229·2	246·2	264·1	282·4	301·3	321·0	341·3	362·3	383·9	406·3	429·3	453·1	477·4	503·5	528·1	554·3	581·3	12
13	200·9	216·3	232·5	248·9	266·2	284·3	302·9	322·4	342·4	362·9	384·2	406·3	429·0	452·2	476·3	501·1	526·2	552·4	578·9	606·4	13
14	220·3	236·0	252·4	269·5	287·0	305·4	324·3	344·0	364·2	385·3	406·9	429·3	452·2	476·0	500·3	525·4	551·1	577·3	604·3	632·1	14
15	240·3	256·2	273·0	290·2	308·3	327·0	346·4	366·4	386·9	408·2	430·4	453·1	476·3	500·3	524·9	550·3	576·4	602·9	630·4	658·3	15
16	261·1	277·3	294·3	312·1	330·2	349·4	369·1	389·3	410·4	432·0	454·4	477·4	501·1	525·4	550·3	575·9	602·4	629·4	656·9	685·3	16
17	282·4	299·0	316·4	334·3	352·9	372·3	392·3	413·1	434·4	456·3	479·0	503·5	526·2	551·1	576·4	602·4	629·1	656·4	684·4	713·1	17
18	304·3	321·3	339·1	357·2	376·4	396·1	416·3	437·4	459·0	481·4	504·4	528·1	552·4	577·3	602·9	629·4	656·4	683·9	712·3	741·4	18
19	327·0	344·2	362·3	381·0	400·4	420·4	440·9	462·2	484·4	507·1	530·3	554·3	578·9	604·3	630·4	656·9	684·4	712·3	740·9	770·3	19
20	350·5	368·0	386·4	405·3	425·0	445·2	466·3	487·9	510·3	533·2	557·0	581·3	606·4	632·1	658·3	685·3	713·1	741·4	770·3	800·0	20

TABLE III.—BASE 20.—SLOPES 1½ to 1.

Feet.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Feet.
0	10·53	21·87	34·56	48·06	62·67	78·03	94·50	112·0	130·4	149·8	170·4	192·0	214·4	237·9	262·4	288·1	314·5	342·1	370·4	399·9	0
1	21·60	33·48	46·44	60·46	75·60	91·53	108·5	126·4	145·5	165·5	186·6	208·4	231·4	255·4	280·5	306·4	333·4	361·5	390·4	420·4	1
2	33·48	45·90	59·40	73·98	89·37	105·8	123·4	142·0	161·5	182·0	203·6	226·0	249·5	274·0	299·4	325·9	353·4	382·0	411·5	442·0	2
3	46·44	59·40	73·44	88·56	104·5	121·5	139·6	158·5	178·5	199·5	221·4	244·3	268·4	293·5	319·4	346·4	374·5	403·4	433·3	464·4	3
4	60·48	73·98	88·56	103·9	120·4	138·0	156·6	176·0	196·6	217·9	240·6	264·1	288·4	314·0	340·5	368·0	396·4	426·1	456·6	487·9	4
5	75·60	89·37	104·5	120·4	137·4	155·5	174·4	194·4	215·5	237·6	260·5	284·6	309·4	335·3	362·3	390·4	419·6	449·5	480·6	512·5	5
6	91·53	105·8	121·5	138·0	155·5	173·9	193·6	213·8	235·4	257·8	281·3	305·9	331·6	358·0	385·6	413·9	443·3	473·8	505·4	537·8	6
7	108·5	123·4	139·6	156·6	174·4	193·6	213·6	234·4	256·5	279·4	303·5	328·6	354·5	381·5	409·6	438·5	468·4	499·5	531·4	564·6	7
8	126·4	142·0	158·5	176·0	194·4	213·8	234·4	256·0	278·4	301·9	326·4	352·1	378·5	406·1	434·4	463·9	494·4	526·0	558·4	591·8	8
9	145·5	161·5	178·5	196·6	215·5	235·4	256·5	278·4	301·3	325·3	350·5	376·4	403·4	431·5	460·3	490·3	521·4	553·5	586·4	620·5	9
10	165·5	182·0	199·5	217·9	237·6	257·8	279·4	301·9	325·3	349·9	375·6	402·0	429·6	457·9	487·3	517·9	549·4	581·8	615·6	649·9	10
11	186·6	203·6	221·4	240·6	260·5	281·3	303·5	326·4	350·5	375·6	401·5	428·5	456·6	485·5	515·4	546·5	578·3	611·5	645·6	680·4	11
12	208·4	226·0	244·3	264·1	284·6	305·9	328·6	352·1	376·4	402·0	428·5	456·0	484·4	513·8	544·6	575·9	608·6	642·1	676·3	712·0	12
13	231·4	249·5	268·4	288·4	309·4	331·6	354·5	378·5	403·4	429·6	456·6	484·4	513·5	543·5	574·6	606·4	639·4	673·4	708·5	744·4	13
14	255·4	274·0	293·5	314·0	335·3	358·0	381·5	406·1	431·5	457·9	485·5	513·8	543·5	574·0	605·3	638·0	671·5	706·0	741·4	777·9	14
15	280·5	299·4	319·4	340·5	362·3	385·6	409·6	434·4	460·3	487·3	515·4	544·6	574·6	605·3	637·5	670·4	704·4	739·5	775·4	812·4	15
16	306·4	325·9	346·4	368·0	390·4	413·9	438·5	463·9	490·3	517·9	546·5	575·9	606·4	638·0	670·4	703·9	738·4	774·1	810·5	848·1	16
17	333·4	353·4	374·5	396·4	419·6	443·3	468·4	494·4	521·4	549·4	578·3	608·6	639·4	671·5	704·4	738·4	773·5	809·5	846·4	884·5	17
18	361·5	382·0	403·4	426·1	449·5	473·8	499·5	526·0	553·5	581·8	611·5	642·1	673·4	706·0	739·5	774·1	809·5	845·9	883·4	922·0	18
19	390·4	411·5	433·3	456·6	480·6	505·4	531·4	558·4	586·4	615·6	645·6	676·3	708·5	741·4	775·4	810·5	846·4	883·4	921·5	960·4	19
20	420·4	442·0	464·4	487·9	512·5	537·8	564·6	591·8	620·5	649·9	680·4	712·0	744·4	777·9	812·4	848·1	884·5	922·0	960·4	1000	20

TABLE IV.—BASE 20.—SLOPES 2 to 1.

Feet.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Feet.
0	10·80	22·68	35·91	50·76	66·69	83·97	102·6	122·6	143·9	166·6	190·6	216·0	242·7	270·5	300·0	330·7	362·6	396·1	430·6	466·6	0
1	21·87	34·56	48·60	63·99	80·75	98·55	118·0	138·5	160·6	183·9	208·7	234·6	261·9	290·5	320·8	352·1	384·7	418·8	453·9	490·6	1
2	34·56	48·06	62·64	78·57	95·85	114·7	134·7	156·1	178·7	202·8	227·9	254·6	282·7	311·8	342·6	374·8	408·0	442·5	478·7	516·0	2
3	48·60	62·64	78·03	94·77	112·6	132·0	152·5	174·7	197·9	222·7	248·7	275·9	304·6	334·5	365·8	398·5	432·5	467·9	504·6	542·7	3
4	63·99	78·57	94·77	112·0	130·7	150·7	172·0	194·7	218·7	244·1	270·5	298·6	328·0	358·6	390·7	423·9	458·7	494·6	531·9	570·5	4
5	80·73	95·85	112·6	130·7	149·8	170·6	192·5	216·0	240·6	266·8	294·0	322·6	352·6	383·9	416·6	450·6	486·0	522·7	560·8	599·9	5
6	98·55	114·7	132·0	150·7	170·6	192·0	214·6	238·7	264·1	290·5	318·6	348·0	378·5	410·7	443·9	478·7	514·6	551·9	590·8	630·7	6
7	118·0	134·7	152·5	172·0	192·5	214·6	237·9	262·7	288·6	315·9	344·5	374·8	406·1	438·7	472·8	507·9	544·6	582·7	622·1	662·6	7
8	138·5	156·1	174·7	194·7	216·0	238·7	262·7	288·1	314·5	342·6	372·1	402·6	434·7	467·9	502·7	538·6	575·9	614·5	654·7	696·1	8
9	160·6	178·7	197·9	218·7	240·6	264·1	288·6	314·5	342·1	370·7	400·7	432·0	464·7	498·7	534·1	570·5	608·6	648·0	688·8	730·6	9
0	183·9	202·8	222·7	244·1	266·8	290·5	315·9	342·6	370·7	399·9	430·6	462·5	496·0	530·5	566·7	604·0	642·6	682·6	723·9	766·8	10
1	208·7	227·9	248·7	270·5	294·0	318·6	344·5	372·1	400·7	430·6	462·0	494·6	528·7	564·0	600·7	638·5	678·0	718·7	760·6	804·1	11
2	234·6	254·6	275·9	298·6	322·6	348·0	374·8	402·6	432·0	462·5	494·6	527·8	562·7	598·6	635·8	674·7	714·7	756·0	798·7	842·7	12
3	261·9	282·7	304·6	328·0	352·6	378·5	406·1	434·7	464·7	496·0	528·7	562·7	598·0	634·8	672·6	712·0	752·8	794·6	838·1	882·6	13
4	290·5	311·8	334·5	358·6	383·9	410·7	438·7	467·9	498·7	530·5	564·0	598·6	634·8	672·0	710·6	750·6	791·9	834·6	878·6	923·9	14
5	320·8	342·6	365·8	390·7	416·6	443·9	472·8	502·7	534·1	566·7	600·7	635·8	672·6	710·6	750·1	790·6	832·7	875·9	920·7	966·6	15
6	352·1	374·8	398·5	423·9	450·6	478·7	507·9	538·6	570·5	604·0	638·5	674·7	712·0	750·6	790·6	831·9	874·5	918·5	963·9	1011·	16
7	384·7	408·0	432·5	458·7	486·0	514·6	544·6	575·9	608·6	642·6	678·0	714·7	752·8	791·9	832·7	874·5	918·0	962·5	1009·	1056·	17
8	418·8	442·5	467·9	494·6	522·7	551·9	582·7	614·5	648·0	682·6	718·7	756·0	794·6	834·6	875·9	918·5	962·5	1008·	1055·	1103·	18
9	453·9	478·7	504·6	531·9	560·8	590·8	622·1	654·7	688·8	723·9	760·6	798·7	838·1	878·6	920·7	963·9	1009·	1055·	1102·	1151·	19
0	490·6	516·0	542·7	570·5	599·9	630·7	662·6	696·1	730·6	766·8	804·1	842·7	882·6	923·9	966·6	1011·	1056·	1103·	1151.	1200·	20

TABLE V.—BASE 22.—SLOPES ½ to 1.

Feet.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Feet.
0	11·15	22·65	34·53	46·68	59·16	71·98	85·13	98·63	112·5	126·6	141·1	156·0	171·1	186·7	202·5	218·6	235·1	252·0	269·2	286·6	0
1	22·49	34·18	46·17	58·51	71·17	84·13	97·47	111·2	125·2	139·5	154·1	169·1	184·5	200·1	216·2	232·5	249·1	266·2	283·5	301·1	1
2	34·18	46·01	58·16	70·66	83·48	96·63	110·2	124·0	138·1	152·6	167·4	182·7	198·1	214·0	230·1	246·6	263·5	280·7	298·2	316·0	2
3	46·17	58·16	70·50	83·13	96·12	109·5	123·2	137·2	151·5	166·1	181·2	196·5	212·2	228·1	244·4	261·2	278·1	295·5	313·1	331·1	3
4	58·51	70·66	83·13	95·96	109·2	122·7	136·5	150·6	165·1	180·0	195·1	210·6	226·5	242·6	259·2	276·0	293·1	310·6	328·4	346·6	4
5	71·17	83·48	96·12	109·2	122·5	136·2	150·1	164·4	179·2	194·1	209·5	225·1	241·1	257·5	274·1	291·1	308·5	326·1	344·1	362·5	5
6	84·13	96·63	109·5	122·7	136·2	150·0	164·1	178·7	193·5	208·6	224·1	240·0	256·2	272·7	289·5	306·6	324·1	341·9	360·2	378·7	6
7	97·47	110·2	123·2	136·5	150·1	164·1	178·5	193·1	208·1	223·5	239·1	255·2	271·5	288·1	305·1	322·5	340·1	358·2	376·2	395·2	7
8	111·2	124·0	137·2	150·6	164·4	178·7	193·1	208·0	223·1	238·6	254·5	270·7	287·1	304·0	321·1	338·6	356·5	374·7	393·2	412·0	8
9	125·2	138·1	151·5	165·1	179·2	193·5	208·1	223·1	238·5	254·2	270·2	286·5	303·1	320·1	337·4	355·2	373·2	391·5	410·1	429·1	9
10	139·5	152·6	166·1	180·0	194·1	208·6	223·5	238·6	254·2	270·0	286·1	302·6	319·5	336·6	354·2	372·0	390·2	408·6	427·5	446·7	10
11	154·1	167·4	181·2	195·1	209·5	224·1	239·1	254·5	270·2	286·1	302·5	319·1	336·1	353·5	371·2	389·2	407·5	426·1	445·2	464·5	11
12	169·1	182·7	196·5	210·6	225·1	240·0	255·2	270·7	286·5	302·6	319·1	336·0	353·2	370·7	388·5	406·6	425·1	444·0	463·2	482·7	12
13	184·5	198·1	212·2	226·5	241·1	256·2	271·5	287·1	303·1	319·5	336·1	353·2	370·5	388·2	406·2	424·5	443·2	462·2	481·5	501·1	13
14	200·1	214·0	228·1	242·6	257·5	272·7	288·1	304·0	320·1	336·6	353·5	370·7	388·2	406·0	424·1	442·7	461·5	480·6	500·1	520·0	14
15	216·2	230·1	244·4	259·2	274·1	289·5	305·1	321·1	337·4	354·2	371·2	388·5	406·2	424·1	442·5	461·2	480·2	499·5	519·1	539·1	15
16	232·5	246·6	261·2	276·0	291·1	306·6	322·5	338·6	355·2	372·0	389·2	406·6	424·5	442·7	461·2	480·0	499·1	518·6	538·5	558·7	16
17	249·1	263·5	278·1	293·1	308·5	324·1	340·1	356·5	373·2	390·2	407·5	425·1	443·2	461·5	480·2	499·1	518·5	538·1	558·2	578·5	17
18	266·2	280·7	295·5	310·6	326·1	341·9	358·2	374·7	391·5	408·6	426·1	444·0	462·2	480·6	499·5	518·6	538·1	558·0	578·2	598·6	18
19	283·5	298·2	313·1	328·4	344·1	360·2	376·5	393·2	410·1	427·5	445·2	463·2	481·5	500·1	519·1	538·5	558·2	578·2	598·5	619·1	19
20	301·1	316·0	331·1	346·6	362·5	378·7	395·2	412·0	429·1	446·7	464·5	482·7	501·1	520·0	539·1	558·7	578·5	598·6	619·1	639·9	20

TABLE VI.—BASE 22.—SLOPES 1 to 1.

Feet.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Feet.
0	11·31	23·30	36·02	49·36	63·31	77·98	93·31	109·3	126·0	143·3	161·3	180·0	199·3	219·3	240·0	261·3	283·3	306·0	329·3	353·3	0
1	22·98	35·34	48·33	61·99	76·33	91·31	107·0	123·3	140·3	158·0	176·3	195·3	215·0	235·3	256·3	278·0	300·3	323·3	347·0	371·3	1
2	35·34	48·01	61·34	75·33	89·96	105·3	121·3	138·0	155·3	173·3	192·0	211·3	231·3	252·0	273·3	295·3	318·0	341·3	365·3	390·0	2
3	48·33	61·34	74·98	89·32	104·3	120·0	136·3	156·0	171·0	189·3	208·3	288·0	248·3	269·3	290·9	313·3	336·3	360·0	384·3	409·3	3
4	61·99	75·33	89·32	104·0	119·3	135·3	152·0	169·3	187·3	206·0	225·3	245·3	266·0	287·3	309·3	332·0	355·3	379·3	404·0	427·6	4
5	76·33	89·96	104·3	119·3	135·0	151·3	168·3	186·0	204·3	223·3	243·0	263·3	284·3	306·0	328·3	351·3	375·0	399·3	424·3	450·0	5
6	91·31	105·3	120·0	135·3	151·3	168·0	185·3	203·3	222·0	241·3	261·3	282·0	303·3	325·3	348·0	371·3	395·3	419·9	445·4	471·3	6
7	107·0	121·3	136·3	152·0	168·3	185·3	203·0	221·3	240·3	260·0	280·3	301·3	323·0	345·3	368·3	391·9	416·3	441·3	467·0	493·3	7
8	123·3	138·0	156·0	169·3	186·0	203·3	221·3	240·0	259·3	279·3	300·0	315·9	343·3	366·0	389·3	413·3	438·0	463·3	489·3	516·0	8
9	140·3	155·3	171·0	187·3	204·3	222·0	240·3	259·3	279·0	299·3	320·3	342·0	364·3	387·3	410·9	435·3	460·3	486·0	512·3	539·3	9
10	158·0	173·3	189·3	206·0	223·3	241·3	260·0	279·3	299·3	320·0	341·3	363·3	386·0	409·3	433·3	458·0	483·3	509·3	536·0	563·3	10
11	176·3	192·0	208·3	225·3	243·0	261·3	280·3	300·0	320·3	341·3	363·0	385·3	408·3	432·0	456·3	481·3	507·0	533·3	560·3	588·0	11
12	195·3	211·3	228·0	245·3	263·3	282·0	301·3	315·9	342·0	363·3	385·3	407·9	431·3	455·3	480·0	505·3	531·3	558·0	585·3	613·3	12
13	215·0	231·3	248·3	266·0	284·3	303·3	323·0	343·3	364·3	386·0	408·3	431·3	455·0	479·3	504·3	530·0	556·4	583·3	611·0	639·3	13
14	235·3	252·0	269·3	287·3	306·0	325·3	345·3	366·0	387·3	409·3	432·0	455·3	479·3	504·0	529·3	555·4	582·0	609·3	637·3	666·0	14
15	256·3	273·3	290·9	309·3	328·3	348·0	368·3	389·3	410·9	433·3	456·3	480·0	504·3	529·3	555·0	581·3	608·3	636·0	664·3	693·3	15
16	278·0	295·3	313·3	332·0	351·3	371·3	391·9	413·3	435·3	458·0	481·3	505·3	530·0	555·4	581·3	608·0	635·3	663·3	691·9	721·3	16
17	300·3	318·0	336·3	355·3	375·0	395·3	416·3	438·0	460·3	483·3	507·0	531·3	556·4	582·0	608·3	635·3	663·0	691·3	720·3	750·0	17
18	323·3	341·3	360·0	379·3	399·3	419·9	441·3	463·3	486·0	509·3	533·3	558·0	583·3	609·3	636·0	663·3	691·3	720·0	749·3	779·3	18
19	347·0	365·3	384·3	404·0	424·3	445·4	467·0	489·3	512·3	536·0	560·3	565·3	611·0	637·3	664·3	691·9	720·3	749·3	779·0	809·3	19
20	371·3	390·0	409·3	427·6	450·0	471·3	493·3	516·0	539·3	563·3	588·0	613·3	639·3	666·0	693·3	721·3	750·0	779·3	809·3	840·0	20

TABLE VII.—BASE 22.—SLOPES 1½ to 1.

Feet.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Feet.
0	11·50	23·98	37·53	52·00	67·50	84·00	101·5	120·0	139·5	160·0	181·5	204·0	227·5	252·0	277·5	304·0	331·5	360·0	389·5	420·0	0
1	23·49	36·53	50·52	65·50	81·49	98·47	116·5	135·5	155·5	176·5	198·5	221·4	245·5	270·5	296·5	323·5	351·4	380·5	410·5	441·5	1
2	36·53	50·00	64·50	79·73	96·47	114·0	132·5	152·0	172·5	194·0	216·4	240·0	264·5	290·0	316·5	343·9	372·5	402·0	432·5	464·0	2
3	50·52	64·50	79·49	95·47	112·4	130·5	149·5	169·5	190·5	212·5	235·5	259·5	284·5	310·5	337·5	365·5	394·5	424·5	455·5	487·4	3
4	65·50	79·73	95·47	112·0	129·5	148·0	167·5	188·0	209·5	232·0	255·5	280·0	305·5	332·0	359·5	388·0	417·5	448·0	479·5	511·9	4
5	81·49	96·47	112·4	129·5	147·5	166·5	186·5	207·5	229·5	252·5	276·5	301·5	327·4	354·5	382·5	411·5	441·5	472·5	504·4	537·5	5
6	98·47	114·0	130·5	148·0	166·5	186·0	206·5	228·0	250·5	274·0	298·5	324·0	350·5	378·0	406·5	436·0	466·4	498·0	530·5	564·0	6
7	116·5	132·5	149·5	167·5	186·5	206·5	227·5	249·5	272·5	296·5	321·5	347·5	374·5	402·5	431·5	461·4	492·4	524·5	557·5	591·5	7
8	135·5	152·0	169·5	188·0	207·5	228·0	249·5	272·0	295·5	320·0	345·5	372·0	399·5	428·0	457·5	487·9	519·5	552·0	585·5	620·0	8
9	155·5	172·5	190·5	209·5	229·5	250·5	272·5	295·5	319·5	344·5	370·5	397·5	425·5	454·5	484·5	515·5	547·5	580·5	614·5	649·5	9
10	176·5	194·0	212·5	232·0	252·5	274·0	296·5	320·0	344·5	370·0	396·5	424·0	452·5	481·9	512·5	544·0	576·5	610·0	644·5	680·0	10
1	198·5	216·4	235·5	255·5	276·5	298·5	321·5	345·5	370·5	396·5	423·5	451·5	480·5	510·5	541·5	573·5	606·5	640·5	675·5	711·5	11
2	221·4	240·0	259·5	280·0	301·5	324·0	347·5	372·0	397·5	424·0	451·5	479·9	509·5	540·0	571·5	604·0	637·5	672·0	707·5	744·0	12
3	245·5	264·5	284·5	305·5	327·4	350·5	374·5	399·5	425·5	452·5	480·5	509·5	539·5	570·5	602·5	635·5	669·5	704·5	740·5	777·5	13
4	270·5	290·0	310·5	332·0	354·5	378·0	402·5	428·0	454·5	481·9	510·5	540·0	570·5	602·0	634·5	668·0	702·5	738·0	774·5	812·0	14
5	296·5	316·5	337·5	359·5	382·5	406·5	431·5	457·5	484·5	512·5	541·5	571·5	602·5	634·5	667·5	701·5	736·5	772·5	809·5	847·5	15
6	323·5	343·9	365·5	388·0	411·5	436·0	461·4	487·9	515·5	544·0	573·5	604·0	635·5	668·0	701·5	736·0	771·5	808·0	845·5	884·0	16
7	351·4	372·5	394·5	417·5	441·5	466·4	492·4	519·5	547·5	576·5	606·5	637·5	669·5	702·5	736·5	771·5	807·5	844·5	882·5	921·5	17
8	380·5	402·0	424·5	448·0	472·5	498·0	524·5	552·0	580·5	610·0	640·5	672·0	704·5	738·0	772·5	808·0	844·5	882·0	920·5	960·0	18
9	410·5	432·5	455·5	479·5	504·4	530·5	557·5	585·5	614·5	644·5	675·5	707·5	740·5	774·5	809·5	845·5	882·5	920·5	959·5	999·5	19
0	441·5	464·0	487·4	511·9	537·5	564·0	591·5	620·0	649·5	680·0	711·5	744·0	777·5	812·0	847·5	884·0	921·5	960·0	999·5	1040·	20

TABLE VIII.—BASE 22.—SLOPES 2 to 1.

Feet.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Feet.
0	11·66	24·65	39·01	54·67	71·66	89·99	109·6	130·6	153·0	176·7	201·7	228·0	255·6	284·7	315·0	346·6	379·6	414·0	449·7	486·7	0
1	23·98	37·69	52·68	69·01	86·64	105·6	125·9	147·7	170·7	195·0	220·6	247·9	276·0	305·7	336·7	369·0	402·6	437·7	474·0	511·6	1
2	37·69	52·00	67·66	84·64	103·0	122·6	143·7	166·0	189·6	214·6	241·0	268·7	297·7	328·0	359·6	392·6	427·0	462·7	499·7	538·0	2
3	52·68	67·66	84·00	101·6	120·6	141·0	162·7	185·6	210·0	235·6	262·7	291·0	320·6	351·6	384·0	417·7	452·6	489·0	526·6	565·6	3
4	69·01	84·64	101·6	120·0	139·7	160·7	183·0	206·6	231·6	258·0	285·7	314·6	345·0	376·6	409·7	444·0	479·6	516·6	555·0	594·6	4
5	86·64	103·0	120·6	139·7	160·0	181·6	204·6	229·0	254·7	281·7	310·0	339·6	370·6	403·0	436·7	471·7	508·0	545·6	584·6	625·0	5
6	105·6	122·6	141·0	160·7	181·6	204·0	227·6	252·7	279·0	306·7	335·6	365·9	397·7	430·6	465·0	500·6	537·6	576·0	615·7	656·7	6
7	125·9	143·7	162·7	183·0	204·6	227·6	252·0	277·7	304·6	333·0	362·6	393·7	426·0	459·6	494·6	530·9	568·6	607·7	648·0	689·7	7
8	147·7	166·0	185·6	206·6	229·0	252·7	277·7	304·0	331·6	360·6	391·0	422·6	455·6	490·0	525·6	562·6	601·0	640·7	681·7	724·0	8
9	170·7	189·6	210·0	231·6	254·7	279·0	304·6	331·6	360·0	389·7	420·7	453·0	486·6	521·6	558·0	595·7	634·7	675·0	716·7	759·6	9
10	195·0	214·6	235·6	258·0	281·7	306·7	333·0	360·6	389·7	420·0	451·6	484·6	519·0	554·6	591·7	630·0	669·6	710·7	753·0	796·7	10
11	220·6	241·0	262·7	285·7	310·0	335·6	362·6	391·0	420·7	451·6	484·0	517·6	552·6	589·0	626·7	665·6	706·0	747·7	790·7	835·0	11
12	247·9	268·7	291·0	314·6	339·6	365·9	393·7	422·6	453·0	484·6	517·6	552·0	587·7	624·7	663·0	702·6	743·6	786·0	829·7	874·7	12
13	276·0	297·7	320·6	345·0	370·6	397·7	426·0	455·6	486·6	519·0	552·6	587·7	624·0	661·7	700·6	741·0	782·7	825·7	870·0	915·6	13
14	305·7	328·0	351·6	376·6	403·0	430·6	459·6	490·0	521·6	554·6	589·0	624·7	661·7	700·0	739·6	780·7	823·0	866·7	911·6	958·0	14
15	336·7	359·6	384·0	409·7	436·7	465·0	494·6	525·6	558·0	591·7	626·7	663·0	700·6	739·6	780·0	821·7	864·7	909·0	954·6	1002·	15
16	369·0	392·6	417·7	444·0	471·7	500·6	530·9	562·6	595·7	630·0	665·6	702·6	741·0	780·7	821·7	864·0	907·6	952·6	999·0	1047·	16
17	402·6	427·0	452·6	479·6	508·0	537·6	568·6	601·0	634·7	669·6	706·0	743·6	782·7	823·0	864·7	907·6	952·0	997·6	1045·	1093·	17
18	437·7	462·7	489·0	516·6	545·6	576·0	607·7	640·7	675·0	710·7	747·7	786·0	825·7	866·7	909·0	952·6	997·6	1044·	1092·	1141·	18
19	474·0	499·7	526·6	555·0	584·6	615·7	648·0	681·7	716·7	753·0	790·7	829·7	870·0	911·6	954·6	999·0	1045·	1092·	1140·	1190·	19
20	511·6	538·0	565·6	594·6	625·0	656·7	689·7	724·0	759·6	796·7	835·0	874·7	915·6	958·0	1002·	1047·	1093·	1141·	1190·	1240·	20

TABLE IX.—BASE 24.—SLOPES ½ to 1.

Feet.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Feet.
0	12·15	24·65	37·53	50·68	64·15	77·98	92·12	106·6	121·5	136·6	152·1	168·0	184·1	200·7	217·5	234·7	252·1	270·0	288·2	306·7	0
1	24·49	37·18	50·17	63·50	77·17	91·12	105·5	120·2	135·2	150·5	166·1	182·1	198·5	215·2	232·2	249·5	267·1	285·2	303·5	322·2	1
2	37·18	50·00	63·15	76·65	90·48	104·6	119·2	134·0	149·1	164·6	180·4	196·7	213·2	230·0	247·1	264·6	282·5	300·7	319·2	338·0	2
3	50·17	63·15	76·49	90·13	104·1	118·5	133·2	148·1	163·4	179·1	195·2	211·5	228·2	245·2	262·5	280·2	298·2	316·5	335·1	354·1	3
4	63·50	76·65	90·13	103·9	118·2	132·6	147·5	162·6	178·1	194·0	210·2	226·7	243·5	260·6	278·2	296·0	314·1	332·6	351·5	370·6	4
5	77·17	90·48	104·1	118·2	132·5	147·1	162·1	177·4	193·2	209·2	225·5	242·2	259·1	276·5	294·2	312·1	330·5	349·1	368·1	387·5	5
6	91·12	104·6	118·5	132·6	147·1	162·0	177·1	192·7	208·5	224·7	241·2	258·0	275·2	292·7	310·5	328·6	347·1	365·9	385·2	404·7	6
7	105·5	119·2	133·2	147·5	162·1	177·1	192·5	208·2	224·1	240·5	257·1	274·2	291·5	309·1	327·1	345·5	364·1	383·2	402·5	422·2	7
8	120·2	134·0	148·1	162·6	177·4	192·7	208·2	224·0	240·2	256·6	273·5	290·7	308·1	326·0	344·1	362·6	381·5	400·7	420·2	440·0	8
9	135·2	149·1	163·4	178·1	193·2	208·5	224·1	240·2	256·5	273·2	290·2	307·5	325·1	343·1	361·4	380·2	399·2	418·5	438·1	458·1	9
10	150·5	164·6	179·1	194·0	209·2	224·7	240·5	256·6	273·2	290·0	307·1	324·6	342·5	360·6	379·2	398·0	417·2	436·6	456·5	476·7	10
11	166·1	180·4	195·2	210·2	225·5	241·2	257·1	273·5	290·2	307·1	324·5	342·1	360·1	378·5	397·2	416·2	435·5	455·1	475·2	495·5	11
12	182·1	196·7	211·5	226·7	242·2	258·0	274·2	290·7	307·5	324·6	342·1	360·0	378·2	396·7	415·5	434·6	454·1	474·0	494·2	514·7	12
13	198·5	213·2	228·2	243·5	259·1	275·2	291·5	308·1	325·1	342·5	360·b	378·2	396·5	415·2	434·2	453·5	473·2	493·2	513·5	534·1	13
14	215·2	230·0	245·2	260·6	276·5	292·7	309·1	326·0	343·1	360·6	378·5	396·7	415·2	434·0	453·1	472·6	492·5	512·6	533·1	553·9	14
15	232·2	247·1	262·5	278·2	294·2	310·5	327·1	344·1	361·4	379·2	397·2	415·5	434·2	453·1	472·5	492·2	512·2	532·5	553·1	574·1	15
16	249·5	264·6	280·2	296·0	312·1	328·6	345·5	362·6	380·2	398·0	416·2	434·6	453·5	472·6	492·2	512·0	532·1	552·6	573·4	594·7	16
17	267·1	282·5	298·2	314·1	330·5	347·1	364·1	381·5	399·2	417·2	435·5	454·1	473·2	492·5	512·2	532·1	552·5	573·1	594·2	615·5	17
18	285·2	300·7	316·5	332·6	349·1	365·9	383·2	400·7	418·5	436·6	455·1	474·0	493·2	512·6	532·5	552·6	573·1	594·0	615·2	636·6	18
19	303·5	319·2	335·1	351·5	368·1	385·2	402·5	420·2	438·1	456·5	475·2	494·2	513·5	533·1	553·1	573·4	594·2	615·2	636·5	658·1	19
20	322·2	338·0	354·1	370·6	387·5	404·7	422·2	440·0	458·1	476·7	495·5	514·7	534·1	553·9	574·1	594·7	615·5	636·6	658·1	679·9	20

TABLE X.—BASE 24.—SLOPES 1 to 1.

Feet.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Feet.
0	12·31	25·30	39·01	53·35	68·31	83·97	100·3	117·3	135·0	153·3	172·3	192·0	212·3	233·4	255·0	277·3	300·3	324·0	348·3	373·3	0
1	24·97	38·34	52·33	66·99	82·32	98·31	115·0	132·3	150·3	169·0	188·2	208·3	229·0	250·3	272·3	295·0	318·3	342·4	367·0	392·3	1
2	38·34	52·00	66·34	81·32	96·96	113·3	130·3	148·0	166·3	185·3	204·9	225·3	246·3	268·0	290·3	313·3	337·0	361·3	386·3	412·0	2
3	52·33	66·34	80·97	96·31	112·3	129·0	146·3	167·0	182·9	202·3	222·3	243·0	264·3	286·3	309·0	332·3	356·3	381·0	406·3	432·3	3
4	66·99	81·32	96·31	112·0	128·3	145·3	163·0	181·3	200·3	220·0	240·3	261·3	283·0	305·3	328·3	352·0	376·3	401·3	427·0	451·6	4
5	82·32	96·96	112·3	128·3	145·0	162·3	180·3	199·0	218·3	238·3	259·0	280·3	302·3	325·0	348·3	372·3	397·0	422·3	448·3	475·0	5
6	98·31	113·3	129·0	145·3	162·3	179·9	198·3	217·3	237·0	257·3	278·3	300·0	322·3	345·3	369·0	393·3	418·3	444·0	470·4	497·3	6
7	115·0	130·3	146·3	163·0	180·3	198·3	217·0	236·3	256·3	277·0	298·3	320·3	343·0	366·3	390·3	415·0	440·3	466·3	493·0	520·3	7
8	132·3	148·0	167·0	181·3	199·0	217·3	236·3	256·0	276·3	297·3	319·0	335·9	364·3	388·0	412·3	437·3	463·0	489·3	516·3	544·0	8
9	150·3	166·3	182·9	200·3	218·3	237·0	256·3	276·3	297·0	318·3	340·3	363·0	386·3	410·3	434·9	460·3	486·3	513·0	540·3	568·3	9
10	169·0	185·3	202·3	220·0	238·3	257·3	277·0	297·3	318·3	340·0	362·3	385·3	409·0	433·3	458·3	484·0	510·3	537·3	565·0	593·3	10
11	188·3	204·9	222·3	240·3	259·0	278·3	298·3	319·0	340·3	362·3	385·0	408·3	432·3	457·0	482·3	508·3	535·0	562·3	590·3	619·0	11
12	208·3	225·3	243·0	261·3	280·3	300·0	320·3	335·9	363·0	385·3	408·3	431·9	456·3	481·3	507·0	533·3	560·3	588·0	616·3	645·3	12
13	229·0	246·3	264·3	283·0	302·3	322·3	343·0	364·3	386·3	409·0	432·3	456·3	481·0	506·3	532·3	559·0	586·3	614·3	643·0	672·3	13
14	250·3	268·0	286·3	305·3	325·0	345·3	366·3	388·0	410·3	433·3	457·0	481·3	506·3	532·0	558·3	585·4	613·0	641·3	670·3	700·0	14
15	272·3	290·3	309·0	328·3	348·3	369·0	390·3	412·3	434·9	458·3	482·3	507·0	532·3	558·3	585·0	612·3	640·3	669·0	698·3	728·3	15
16	295·0	313·3	332·3	352·0	372·3	393·3	415·0	437·3	460·3	484·0	508·3	533·3	559·0	585·4	612·3	640·0	668·3	697·3	726·9	757·3	16
17	318·3	337·0	356·3	376·3	397·0	418·3	440·3	463·0	486·3	510·3	535·0	560·3	586·3	613·0	640·3	668·3	697·0	726·3	756·3	787·0	17
18	342·4	361·3	381·0	401·3	422·3	444·0	466·3	489·3	513·0	537·3	562·3	588·0	614·3	641·3	669·0	697·3	726·3	756·0	786·3	817·3	18
19	367·0	386·3	406·3	427·0	448·3	470·4	493·0	516·3	540·3	565·0	590·3	616·3	643·0	670·3	698·3	726·9	756·3	786·3	817·0	848·3	19
20	392·3	412·0	432·3	451·6	475·0	497·3	520·3	544·0	568·3	593·3	619·0	645·3	672·3	700·0	728·3	757·3	787·0	817·3	848·3	879·9	20

TABLE XI.—BASE 24.—SLOPES 1½ to 1.

Feet.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Feet.
0	12·50	25·97	40·53	55·99	72·49	89·99	108·4	127·9	148·5	170·0	192·5	216·0	240·5	266·0	292·5	320·0	348·5	378·0	408·5	440·0	0
1	25·49	39·53	54·51	70·50	87·48	105·5	124·5	144·5	165·5	187·5	210·5	234·4	259·5	285·5	312·5	340·5	369·5	399·5	430·5	462·5	1
2	39·53	54·00	69·50	85·99	103·5	121·9	141·5	162·0	183·5	205·9	229·4	254·0	279·5	306·0	333·5	362·0	391·5	422·0	453·5	486·0	2
3	54·51	69·50	85·48	102·5	120·4	139·5	159·5	180·5	202·5	225·4	249·5	274·5	300·5	327·5	355·5	384·5	414·5	445·5	477·5	510·5	3
4	70·50	85·99	102·5	120·0	138·5	158·0	178·5	200·0	222·4	246·0	270·5	296·0	322·5	350·0	378·5	408·0	438·5	470·0	502·5	535·9	4
5	87·48	103·5	120·4	138·5	157·5	177·5	198·5	220·4	243·5	267·5	292·5	318·5	345·5	373·5	402·5	432·5	463·5	495·5	528·4	562·5	5
6	105·5	121·9	139·5	158·0	177·5	198·0	219·4	242·0	265·5	290·0	315·5	342·0	369·5	398·0	427·5	458·0	489·4	522·0	555·5	590·0	6
7	124·5	141·5	159·5	178·5	198·5	219·4	241·5	264·5	288·5	313·5	339·5	366·5	394·5	423·5	453·5	484·5	516·4	549·5	583·5	618·5	7
8	144·5	162·0	180·5	200·0	220·4	242·0	264·5	288·0	312·5	338·0	364·5	392·0	420·5	450·0	480·5	511·9	544·5	578·0	612·5	648·0	8
9	165·5	183·5	202·5	222·4	243·5	265·5	288·5	312·5	337·5	363·5	390·5	418·5	447·5	477·5	508·5	540·5	573·5	607·5	642·5	678·5	9
10	187·5	205·9	225·4	246·0	267·5	290·0	313·5	338·0	363·5	390·0	417·5	446·0	475·5	505·9	537·5	570·0	603·5	638·0	673·5	710·0	10
11	210·5	229·4	249·5	270·5	292·5	315·5	339·5	364·5	390·5	417·5	445·5	474·5	504·5	535·5	567·5	600·5	634·5	669·5	705·5	742·5	11
12	234·4	254·0	274·5	296·0	318·5	342·0	366·5	392·0	418·5	446·0	474·5	503·9	534·5	566·0	598·5	632·0	666·5	702·0	738·5	776·0	12
13	259·5	279·5	300·5	322·5	345·5	369·5	394·5	420·5	447·5	475·5	504·5	534·5	565·5	597·5	630·5	664·5	699·5	735·5	772·5	810·5	13
14	285·5	306·0	327·5	350·0	373·5	398·0	423·5	450·0	477·5	505·9	535·5	566·0	597·5	630·0	663·5	698·0	733·5	769·9	807·5	846·0	14
15	312·5	333·5	355·5	378·5	402·5	427·5	453·5	480·5	508·5	537·5	567·5	598·5	630·5	663·5	697·5	732·5	768·5	805·5	843·5	882·5	15
16	340·5	362·0	384·5	408·0	432·5	458·0	484·5	511·9	540·5	570·0	600·5	632·0	664·5	698·0	732·5	768·0	804·5	842·0	880·5	920·0	16
17	369·5	391·5	414·5	438·5	463·5	489·4	516·4	544·5	573·5	603·5	634·5	666·5	699·5	733·5	768·5	804·5	841·5	879·5	918·5	958·5	17
18	399·5	422·0	445·5	470·0	495·5	522·0	549·5	578·0	607·5	638·0	669·5	702·0	735·5	769·9	805·5	842·0	879·5	918·0	957·5	998·0	18
19	430·5	453·5	477·5	502·5	528·4	555·5	583·5	612·5	642·5	673·5	705·5	738·5	772·5	807·5	843·5	880·5	918·5	957·5	997·5	1038·	19
20	462·5	486·0	510·5	535·9	562·5	590·0	618·5	648·0	678·5	710·0	742·5	776·0	810·5	846·0	882·5	920·0	958·5	998·0	1038·	1080·	20

TABLE XII.—BASE 24.—SLOPES 2 to 1.

Feet.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Feet
0	12·66	26·65	42·01	58·67	76·65	95·98	116·6	138·6	162·0	186·6	212·6	240·0	268·6	298·7	330·0	362·7	396·6	432·0	468·7	506·7	0
1	25·97	40·69	56·67	74·01	92·64	112·6	133·9	156·6	180·6	206·0	232·6	260·9	290·0	320·7	352·7	386·0	420·6	456·7	494·0	532·6	1
2	40·69	56·00	72·66	90·64	110·0	130·6	152·6	176·0	200·6	226·6	254·0	282·7	312·7	344·0	376·6	410·6	446·0	482·7	520·7	560·0	2
3	56·67	72·66	89·99	108·6	128·6	150·0	172·7	196·6	222·0	248·6	276·7	306·0	336·7	368·6	402·0	436·7	472·7	510·0	548·6	588·6	3
4	74·01	90·64	108·6	127·9	148·7	170·7	194·0	218·6	244·6	272·0	300·7	330·7	362·0	394·6	428·7	464·0	500·7	538·6	578·0	618·6	4
5	32·64	110·0	128·6	148·7	170·0	192·6	216·6	241·9	268·7	296·7	326·0	356·6	388·6	422·0	456·7	492·7	530·0	568·5	608·6	650·0	5
6	112·6	130·6	150·0	170·7	192·6	216·0	240·6	266·7	294·0	322·7	352·6	384·0	416·7	450·6	486·0	522·6	560·6	600·0	640·7	682·7	6
7	133·9	152·6	172·7	194·0	216·6	240·6	266·0	292·7	320·6	350·0	380·6	412·7	446·0	480·6	516·6	553·9	592·6	632·7	674·0	716·7	7
8	156·6	176·0	196·6	218·6	241·9	266·7	292·7	320·0	348·6	378·6	410·0	442·7	476·6	512·0	548·6	586·6	626·0	674·0	708·7	752·0	8
9	180·6	200·6	222·0	244·6	268·7	294·0	320·6	348·6	378·0	408·7	440·7	474·0	508·6	544·6	581·9	620·7	660·7	702·0	744·7	788·6	9
10	206·0	226·6	248·6	272·0	296·7	322·7	350·0	378·6	408·7	440·0	472·7	506·6	542·0	578·6	616·7	656·0	696·6	738·7	782·0	826·7	10
11	232·6	254·0	276·7	300·7	326·0	352·6	380·6	410·0	440·7	472·7	506·0	540·6	576·6	614·0	652·7	692·6	734·0	776·6	820·7	866·0	11
12	260·9	282·7	306·0	330·7	356·6	384·0	412·7	442·7	474·0	506·6	540·6	576·0	612·7	650·7	690·0	730·6	772·6	816·0	860·7	906·7	12
13	290·0	312·7	336·7	362·0	388·6	416·7	446·0	476·6	508·6	542·0	576·6	612·7	650·0	688·7	728·6	770·0	812·7	856·7	902·0	948·6	13
14	320·7	344·0	368·6	394·6	422·0	450·6	480·6	512·0	544·6	578·6	614·0	650·7	688·7	728·0	768·6	810·7	854·0	898·7	944·6	992·0	14
15	352·7	376·6	402·0	428·7	456·7	486·0	516·6	548·6	581·9	616·7	652·7	690·0	728·6	768·6	810·0	852·7	896·7	942·0	988·6	1037·	15
16	386·0	410·6	436·7	464·0	492·7	522·6	553·9	586·6	620·7	656·0	692·6	730·6	770·0	810·7	852·7	896·0	940·6	986·6	1034·	1083·	16
17	420·6	446·0	472·7	500·7	530·0	560·6	592·6	626·0	660·7	696·6	734·0	772·6	812·7	854·0	896·7	940·6	985·9	1033·	1081·	1130·	17
18	456·7	482·7	510·0	538·6	568·6	600·0	632·7	674·0	702·0	738·7	776·6	816·0	856·7	898·7	942·0	986·6	1033·	1080·	1129·	1179·	18
19	494·0	520·7	548·6	578·0	608·6	640·7	674·0	708·7	744·7	782·0	820·7	860·7	902·0	944·6	988·6	1034·	1081·	1129·	1178·	1229·	19
20	532·6	560·0	588·6	618·6	650·0	682·7	716·7	752·0	788·6	826·7	866·0	906·7	948·6	992·0	1037·	1083·	1130·	1179·	1229·	1280·	20

TABLE XIII.—BASE 26.—SLOPES ½ to 1.

Feet.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Feet.
0	13·15	26·65	40·53	54·67	69·15	83·97	99·12	114·6	130·5	146·7	163·2	180·0	197·1	214·7	232·5	250·6	269·1	287·9	307·2	326·7	0
1	26·49	40·18	54·16	68·50	83·16	98·12	113·4	129·2	145·2	161·5	178·1	195·1	212·5	230·1	248·1	266·5	285·1	304·2	323·5	343·2	1
2	40·18	54·00	68·15	82·65	97·47	112·6	128·2	144·0	160·2	176·6	193·4	210·7	228·1	246·0	264·1	282·6	301·5	320·7	340·2	360·0	2
3	54·16	68·15	82·48	97·12	112·1	127·5	143·2	159·2	175·5	192·1	209·2	226·5	244·2	262·1	280·4	299·2	318·2	337·5	357·1	377·1	3
4	68·50	82·65	97·12	111·9	127·2	142·7	158·5	174·6	191·1	208·0	225·1	242·6	260·5	278·6	297·2	316·0	335·1	354·6	374·5	394·6	4
5	83·16	97·47	112·1	127·2	142·5	158·2	174·1	190·4	207·2	224·1	241·5	259·1	277·1	295·5	314·2	333·1	352·5	372·1	392·1	412·5	5
6	98·12	112·6	127·5	142·7	158·2	174·0	190·1	206·7	223·5	240·6	258·1	276·0	294·2	312·7	331·5	350·6	370·1	390·0	410·2	430·7	6
7	113·4	128·2	143·2	158·5	174·1	190·1	206·5	223·1	240·1	257·5	275·1	293·2	311·5	330·1	349·2	368·5	388·1	408·2	428·5	449·2	7
8	129·2	144·0	159·2	174·6	190·4	206·7	223·1	240·0	257·1	274·6	292·5	310·7	329·1	348·0	367·1	386·6	406·5	426·7	447·2	468·0	8
9	145·2	160·2	175·5	191·1	207·2	223·5	240·1	257·1	274·4	292·2	310·2	328·5	347·1	366·1	385·4	405·2	425·2	445·5	466·1	487·1	9
10	161·5	176·6	192·1	208·0	224·1	240·6	257·5	274·6	292·2	310·0	328·1	346·6	365·5	384·6	404·2	424·0	444·2	464·6	485·5	506·7	10
11	178·1	193·4	209·2	225·1	241·5	258·1	275·1	292·5	310·2	328·1	346·5	365·1	384·1	403·5	423·2	443·2	463·5	484·1	505·2	526·5	11
12	195·1	210·7	226·5	242·6	259·1	276·0	293·2	310·7	328·5	346·6	365·1	384·0	403·2	422·7	442·5	462·6	483·1	504·0	525·2	546·7	12
13	212·5	228·1	244·2	260·5	277·1	294·2	311·5	329·1	347·1	365·5	384·1	403·2	422·5	442·2	462·1	482·5	503·2	524·2	545·5	567·1	13
14	230·1	246·0	262·1	278·6	295·5	312·7	330·1	348·0	366·1	384·6	403·5	422·7	442·2	462·0	482·1	502·7	523·5	544·6	566·1	587·9	14
15	248·1	264·1	280·4	297·2	314·2	331·5	349·2	367·1	385·4	404·2	423·2	442·5	462·1	482·1	502·5	523·2	544·1	565·5	587·1	609·1	15
16	266·5	282·6	299·2	316·0	333·1	350·6	368·5	386·6	405·2	424·0	443·2	462·6	482·5	502·7	523·2	544·0	565·1	586·6	608·4	630·7	16
17	285·1	301·5	318·2	335·1	352·5	370·1	388·1	406·5	425·2	444·2	463·5	483·1	503·2	523·5	544·1	565·1	586·5	608·1	630·2	652·5	17
18	304·2	320·7	337·5	354·6	372·1	390·0	408·2	426·7	445·5	464·6	484·1	504·0	524·2	544·6	565·5	586·6	608·1	630·0	652·2	674·6	18
19	323·5	340·2	357·1	374·5	392·1	410·2	428·5	447·2	466·1	485·5	505·2	525·2	545·5	566·1	587·1	608·4	630·2	652·2	674·5	697·1	19
20	343·2	360·0	377·1	394·6	412·5	430·7	449·2	468·0	487·1	506·7	526·5	546·7	567·1	587·9	609·1	630·7	652·5	674·6	697·1	719·9	20

TABLE XIV.—BASE 26.—SLOPES 1 to 1.

Feet.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Feet.
0	13·31	27·30	42·01	57·35	73·30	89·96	107·3	125·3	144·0	163·3	183·3	204·0	225·3	247·3	270·0	293·3	317·3	341·9	367·4	393·3	0
1	26·97	41·34	56·32	71·98	88·32	105·3	122·9	141·3	160·3	180·0	200·3	221·3	243·0	265·3	288·3	311·9	336·3	361·4	387·0	413·3	1
2	41·34	56·00	71·33	87·32	103·9	121·3	139·3	158·0	177·3	197·3	218·0	239·3	261·3	284·0	307·3	331·3	356·0	381·3	407·3	434·0	2
3	56·32	71·33	86·97	103·3	120·3	138·0	156·3	178·0	195·0	215·3	236·3	258·0	280·3	303·3	326·9	351·3	376·3	402·0	428·3	455·3	3
4	71·98	87·32	103·3	120·0	137·3	155·3	174·0	193·3	213·3	234·0	255·3	277·3	300·0	323·3	347·3	372·0	397·3	423·3	450·0	475·6	4
5	88·32	103·9	120·3	137·3	155·0	173·3	192·3	212·0	232·3	253·3	275·0	297·3	320·3	344·0	368·3	393·3	419·0	445·3	472·3	500·0	5
6	105·3	121·3	138·0	155·3	173·3	192·0	211·3	231·3	252·0	273·3	295·3	317·9	341·4	365·3	390·0	415·3	441·3	468·0	495·4	523·3	6
7	122·9	139·3	156·3	174·0	192·3	211·3	231·0	251·3	272·3	294·0	316·3	339·4	363·0	387·3	412·3	438·0	464·3	491·3	519·0	547·3	7
8	141·3	158·0	178·0	193·3	212·0	231·3	251·3	272·0	293·3	315·3	338·0	355·9	385·3	410·0	435·3	461·3	488·0	515·3	543·3	572·0	8
9	160·3	177·3	195·0	213·3	232·3	252·0	272·3	293·3	314·9	337·4	360·3	384·0	408·3	433·3	458·9	485·3	512·3	540·0	568·3	597·3	9
10	180·0	197·3	215·3	234·0	253·3	273·3	294·0	315·3	337·4	360·0	383·3	407·3	432·0	457·3	483·3	510·0	537·3	565·3	594·0	623·3	10
11	200·3	218·0	236·3	255·3	275·0	295·3	316·3	338·0	360·3	383·3	407·0	431·3	456·3	482·0	508·3	535·3	563·0	591·3	620·3	650·0	11
12	221·3	239·3	258·0	277·3	297·3	317·9	339·4	355·9	384·0	407·3	431·3	455·9	481·3	507·3	534·0	561·3	589·3	618·0	647·3	677·3	12
13	243·0	261·3	280·3	300·0	320·3	341·4	363·0	385·3	408·3	432·0	456·3	481·3	507·0	533·3	560·3	588·0	616·3	645·3	675·0	705·3	13
14	265·3	284·0	303·3	323·3	344·0	365·3	387·3	410·0	433·3	457·3	482·0	507·3	533·3	560·0	587·3	615·3	644·0	673·3	703·3	734·0	14
15	288·3	307·3	326·9	347·3	368·3	390·0	412·3	435·3	458·9	483·3	508·3	534·0	560·3	587·3	615·0	643·3	672·3	702·0	732·3	763·3	15
16	311·9	331·3	351·3	372·0	393·3	415·3	438·0	461·3	485·3	510·0	535·3	561·3	588·0	615·3	643·3	672·0	701·3	731·3	761·9	793·3	16
17	336·3	356·0	376·3	397·3	419·0	441·3	464·3	488·0	512·3	537·3	563·0	589·3	616·3	644·0	672·3	701·3	731·0	761·3	792·3	824·0	17
18	361·4	381·3	402·0	423·3	445·3	468·0	491·3	515·3	540·0	565·3	591·3	618·0	645·3	673·3	702·0	731·3	761·3	792·0	823·3	855·3	18
19	387·0	407·3	428·3	450·0	472·3	495·4	519·0	543·3	568·3	594·0	620·3	647·3	675·0	703·3	732·3	761·9	792·3	823·3	855·0	887·3	19
20	413·3	434·0	455·3	475·6	500·0	523·3	547·3	572·0	597·3	623·3	650·0	677·3	705·3	734·0	763·3	793·3	824·0	855·3	887·3	920·0	20

TABLE XV.—BASE 26.—SLOPES 1½ to 1.

Feet.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Feet.
0	13·50	27·97	43·52	59·99	77·49	95·98	115·4	135·9	157·5	180·0	203·5	288·0	253·5	280·0	307·5	336·0	365·5	395·9	427·5	460·0	0
1	27·51	42·52	58·51	75·49	93·47	112·4	132·5	153·5	175·5	198·5	222·5	247·4	273·5	300·5	328·5	357·5	387·4	418·5	450·5	483·5	1
2	42·52	58·00	74·49	91·99	110·4	129·9	150·5	172·0	194·5	218·0	242·5	268·0	294·5	322·0	350·5	379·9	410·5	442·0	474·5	508·0	2
3	58·51	74·49	91·48	109·4	128·4	148·5	169·5	191·5	214·5	238·5	263·5	289·5	316·5	344·5	373·5	403·5	434·5	466·5	499·5	533·5	3
4	75·49	91·99	109·4	127·9	147·5	168·0	189·5	212·0	235·5	260·0	285·5	312·0	339·5	367·9	397·5	428·0	459·5	492·0	525·5	559·9	4
5	93·47	110·4	128·4	147·5	167·5	188·5	210·5	233·5	257·5	282·5	308·5	335·5	363·4	392·5	422·5	453·5	485·5	518·5	552·4	557·5	5
6	112·4	129·9	148·5	168·0	188·5	210·0	232·5	256·0	280·5	306·0	332·5	360·0	388·5	418·0	448·5	480·0	512·5	546·0	580·5	616·0	6
7	132·5	150·5	169·5	189·5	210·5	232·5	255·5	279·5	304·5	330·5	357·4	385·5	414·5	444·5	475·5	507·5	540·4	574·5	609·5	645·5	7
8	153·5	172·0	191·5	212·0	233·5	256·0	279·5	304·0	329·5	356·0	383·5	412·0	441·5	472·0	503·5	535·9	569·5	604·0	639·5	676·0	8
9	175·5	194·5	214·5	235·5	257·5	280·5	304·5	329·5	355·4	382·5	410·5	439·5	469·5	500·5	532·5	565·5	599·5	634·5	670·5	707·5	9
10	198·5	218·0	238·5	260·0	282·5	306·0	330·5	356·0	382·5	410·0	438·5	468·0	498·5	529·9	562·5	596·0	630·5	666·0	702·5	740·0	10
11	222·5	242·5	263·5	285·5	308·5	332·5	357·4	383·5	410·5	438·5	467·5	497·5	528·5	560·5	593·5	627·5	662·5	698·5	735·5	773·5	11
12	247·4	268·0	289·5	312·0	335·5	360·0	385·5	412·0	439·5	468·0	497·5	527·9	559·5	592·0	625·5	660·0	695·5	732·0	769·5	808·0	12
13	273·5	294·5	316·5	339·5	363·4	388·5	414·5	441·5	469·5	498·5	528·5	559·5	591·5	624·5	658·5	693·5	729·5	766·5	804·5	843·5	13
14	300·5	322·0	344·5	367·9	392·5	418·0	444·5	472·0	500·5	529·9	560·5	592·0	624·5	658·0	692·5	728·0	764·5	802·0	840·5	879·9	14
15	328·5	350·5	373·5	397·5	422·5	448·5	475·5	503·5	532·6	562·5	593·5	625·5	658·5	692·5	727·5	763·5	800·5	838·5	877·5	917·5	15
16	357·5	379·9	403·5	428·0	453·5	480·0	507·5	535·9	565·5	596·0	627·5	660·0	693·5	728·0	763·5	800·0	837·5	876·0	915·5	956·0	16
17	387·4	410·5	434·5	459·5	485·5	512·5	540·4	569·5	599·5	630·5	662·5	695·5	729·5	764·5	800·5	837·5	875·5	914·5	954·5	995·5	17
18	418·5	442·0	466·5	492·0	518·5	546·0	574·5	604·0	634·5	666·0	698·5	732·0	766·5	802·0	838·5	876·0	914·5	954·0	994·5	1036·	18
19	450·5	474·5	499·5	525·5	552·4	580·5	609·5	639·5	670·5	702·5	735·5	769·5	804·5	840·5	877·5	915·5	954·5	994·5	1035·	1077·	19
20	483·5	508·0	533·5	559·9	587·5	616·0	645·5	676·0	707·5	740·0	773·5	808·0	843·5	879·9	917·5	956·0	995·5	1036·	1077·	1120·	20

TABLE XVI.—BASE 26.—SLOPES 2 to 1.

Feet.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Feet
0	13·66	28·65	45·01	62·67	81·65	102·0	123·6	146·6	171·0	196·7	223·7	252·0	281·6	312·7	345·0	378·6	413·6	449·9	487·7	526·7	0
1	27·97	43·69	60·67	79·00	98·63	119·6	141·9	165·7	190·7	217·0	244·6	273·9	304·0	335·7	368·6	403·0	438·6	475·7	514·0	553·7	1
2	43·69	59·99	77·65	96·63	117·0	138·6	161·7	186·0	211·6	238·6	267·0	296·7	327·7	360·0	393·6	428·6	465·0	502·7	541·7	582·0	2
3	60·67	77·65	95·98	115·6	136·6	159·0	182·7	207·6	234·0	261·6	290·7	321·0	352·6	385·6	419·9	455·7	492·7	531·0	570·6	611·6	3
4	79·00	96·63	115·6	135·9	157·7	180·7	205·0	230·6	257·6	286·0	315·6	346·6	379·0	412·6	447·7	484·0	521·7	560·6	601·0	642·6	4
5	98·63	117·0	136·6	157·7	180·0	203·7	228·6	255·0	282·7	311·7	342·0	373·6	406·6	441·0	476·7	513·7	552·0	591·6	632·6	675·0	5
6	119·6	138·6	159·0	180·7	203·7	228·0	253·6	280·7	309·0	338·7	369·6	401·9	435·7	470·7	507·0	544·6	583·6	624·0	665·7	708·7	6
7	141·9	161·7	182·7	205·0	228·6	253·6	280·0	307·7	336·6	366·9	398·6	431·7	466·0	501·7	538·6	577·0	616·6	657·7	700·0	743·7	7
8	165·7	186·0	207·6	230·6	255·0	280·7	307·7	336·0	365·6	396·6	429·0	462·7	497·7	534·0	571·6	610·6	651·0	692·7	735·7	780·0	8
9	190·7	211·6	234·0	257·6	282·7	309·0	336·6	365·6	395·9	427·7	460·7	495·0	530·6	567·6	606·0	645·7	686·7	729·0	772·6	817·6	9
10	217·0	238·6	261·6	286·0	311·7	338·7	366·9	396·6	427·7	460·0	493·7	528·7	565·0	602·6	641·7	682·0	723·6	766·7	811·0	856·7	10
11	244·6	267·0	290·7	315·6	342·0	369·6	398·6	429·0	460·7	493·7	528·0	563·6	600·6	639·0	678·7	719·6	762·0	805·6	850·7	897·0	11
12	273·9	296·7	321·0	346·6	373·6	401·9	431·7	462·7	495·0	528·7	563·6	600·0	637·7	676·7	717·0	758·6	801·6	846·0	891·7	938·6	12
13	304·0	327·7	352·6	379·0	406·6	435·7	466·0	497·7	530·6	565·0	600·6	637·7	676·0	715·7	756·6	799·0	842·7	887·7	934·0	981·6	13
14	335·7	360·0	385·6	412·6	441·0	470·7	501·7	534·0	567·6	602·6	639·0	676·7	715·7	756·0	797·6	840·7	885·0	930·7	977·6	1026·	14
15	368·6	393·6	419·9	447·7	476·7	507·0	538·6	571·6	606·0	641·7	678·7	717·0	756·6	797·6	840·0	883·6	928·7	975·0	1023·	1072·	15
16	403·0	428·6	455·7	484·0	513·7	544·6	577·0	610·6	645·7	682·0	719·6	758·6	799·0	840·7	883·6	928·0	973·6	1021·	1069·	1119·	16
17	438·6	465·0	492·7	521·7	552·0	583·6	616·6	651·0	686·7	723·6	762·0	801·6	842·7	885·0	928·7	973·6	1020·	1068·	1117·	1167·	17
18	475·7	502·7	531·0	560·6	591·6	624·0	657·7	692·7	729·0	766·7	805·6	846·0	887·7	930·7	975·0	1021·	1068·	1116·	1166·	1217·	18
19	514·0	541·7	570·6	601·0	632·6	665·7	700·0	735·7	772·6	811·0	850·7	891·7	934·0	977·6	1023·	1069·	1117·	1166·	1216·	1268·	19
20	553·7	582·0	611·6	642·6	675·0	708·7	743·7	780·0	817·6	856·7	897·0	938·6	981·6	1026·	1072·	1119·	1167·	1217·	1268·	1320·	20

TABLE XVII.—BASE 1.—SLOPES ½ to 1.

Feet.	1		2		3		4		5		Feet.
	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	
0	·0185	·006	·0370	·025	·0556	·056	·0741	·099	·0926	·154	0
1	·0370	·019	·0556	·043	·0741	·080	·0926	·130	·1111	·192	1
2	·0556	·043	·0741	·074	·0926	·117	·1111	·173	·1296	·241	2
3	·0741	·080	·0926	·117	·1111	·167	·1296	·228	·1481	·302	3
4	·0926	·130	·1111	·173	·1296	·228	·1481	·296	·1667	·377	4
5	·1111	·192	·1296	·241	·1481	·302	·1667	·377	·1852	·463	5
6	·1296	·265	·1481	·321	·1667	·389	·1852	·469	·2037	·562	6
7	·1481	·352	·1667	·414	·1852	·488	·2037	·574	·2222	·673	7
8	·1667	·451	·1852	·519	·2037	·599	·2222	·691	·2407	·796	8
9	·1852	·562	·2037	·636	·2222	·722	·2407	·821	·2593	·932	9
10	·2037	·685	·2222	·765	·2407	·858	·2593	·963	·2778	1·080	10
11	·2222	·821	·2407	·907	·2593	1·006	·2778	1·117	·2963	1·241	11
12	·2407	·969	·2593	1·062	·2778	1·167	·2963	1·284	·3148	1·414	12
13	·2593	1·130	·2778	1·228	·2963	1·340	·3148	1·463	·3333	1·599	13
14	·2778	1·302	·2963	1·407	·3148	1·525	·3333	1·654	·3519	1·796	14
15	·2963	1·488	·3148	1·599	·3333	1·722	·3519	1·858	·3704	2·006	15
16	·3148	1·685	·3333	1·802	·3519	1·932	·3704	2·074	·3889	2·228	16
17	·3333	1·895	·3519	2·019	·3704	2·154	·3889	2·302	·4074	2·463	17
18	·3519	2·117	·3704	2·247	·3889	2·389	·4074	2·543	·4259	2·710	18
19	·3704	2·352	·3889	2·488	·4074	2·636	·4259	2·796	·4444	2·969	19
20	·3889	2·599	·4074	2·741	·4259	2·895	·4444	3·062	·4630	3·241	20
21	·4074	2·858	·4259	3·006	·4444	3·167	·4640	3·340	·4815	3·525	21
22	·4259	3·130	·4444	3·284	·4630	3·451	·4815	3·630	·5000	3·821	22
23	·4444	3·414	·4630	3·574	·4815	3·747	·5000	3·932	·5185	4·130	23
24	·4630	3·710	·4815	3·877	·5000	4·056	·5185	4·247	·5370	4·451	24
25	·4815	4·019	·5000	4·191	·5185	4·377	·5370	4·574	·5556	4·784	25
26	·5000	4·340	·5185	4·519	·5370	4·710	·5556	4·914	·5741	5·130	26
27	·5185	4·673	·5370	4·858	·5556	5·056	·5741	5·265	·5926	5·488	27
28	·5370	5·019	·5556	5·210	·5741	5·414	·5926	5·630	·6111	5·858	28
29	·5556	5·377	·5741	5·574	·5926	5·784	·6111	6·006	·6296	6·241	29
30	·5741	5·747	·5926	5·951	·6111	6·167	·6296	6·395	·6481	6·636	30
31	·5926	6·130	·6111	6·340	·6296	6·562	·6481	6·796	·6667	7·043	31
32	·6111	6·525	·6296	6·741	·6481	6·969	·6667	7·210	·6852	7·463	32
33	·6296	6·932	·6481	7·154	·6667	7·389	·6852	7·636	·7037	7·895	33
34	·6481	7·352	·6667	7·580	·6852	7·821	·7037	8·074	·7222	8·340	34
35	·6667	7·784	·6852	8·019	·7037	8·265	·7222	8·525	·7407	8·796	35
36	·6852	8·228	·7037	8·469	·7222	8·722	·7407	8·988	·7593	9·265	36
37	·7037	8·685	·7222	8·932	·7407	9·191	·7593	9·463	·7778	9·747	37
38	·7222	9·154	·7407	9·407	·7593	9·673	·7778	9·951	·7963	10·241	38
39	·7407	9·636	·7593	9·895	·7778	10·167	·7963	10·451	·8148	10·747	39
40	·7593	10·130	·7778	10·395	·7963	10·673	·8148	10·963	·8333	11·265	40

TABLE XVIII.—BASE 1.—SLOPES ½ to 1.

Feet.	6		7		8		9		10		Feet.
	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	
0	·1111	·222	·1296	·302	·1481	·395	·1667	·500	·1852	·617	0
1	·1296	·265	·1481	·352	·1667	·451	·1852	·562	·2037	·685	1
2	·1481	·321	·1667	·414	·1852	·519	·2037	·636	·2222	·765	2
3	·1667	·389	·1852	·488	·2037	·599	·2222	·722	·2407	·858	3
4	·1852	·469	·2037	·574	·2222	·691	·2407	·821	·2593	·963	4
5	·2037	·562	·2222	·673	·2407	·796	·2593	·932	·2778	1·080	5
6	·2222	·667	·2407	·784	·2593	·914	·2778	1·056	·2963	1·210	6
7	·2407	·784	·2593	·907	·2778	1·043	·2963	1·191	·3148	1·352	7
8	·2593	·914	·2778	1·043	·2963	1·185	·3148	1·340	·3333	1·506	8
9	·2778	1·056	·2963	1·191	·3148	1·340	·3333	1·500	·3519	1·673	9
10	·2963	1·210	·3148	1·352	·3333	1·506	·3519	1·673	·3704	1·852	10
11	·3148	1·377	·3333	1·525	·3519	1·685	·3704	1·858	.3889	2·043	11
12	·3333	1·556	·3519	1·710	·3704	1·877	·3889	2·056	·4074	2·247	12
13	·3519	1·747	·3704	1·907	·3889	2·080	·4074	2·265	·4259	2·463	13
14	·3704	1·951	·3889	2·117	·4074	2·296	·4259	2·488	·4444	2·691	14
15	·3889	2·167	·4074	2·340	·4259	2·525	·4444	2·722	·4630	2·932	15
16	·4074	2·395	·4259	2·574	·4444	2·765	·4630	2·969	·4815	3·185	16
17	·4259	2·636	·4444	2·821	·4630	3·019	·4815	3·228	·5000	3·451	17
18	·4444	2·889	·4630	3·080	·4815	3·284	·5000	3·500	·5185	3·728	18
19	·4630	3·154	·4815	3·352	·5000	3·562	·5185	3·784	·5370	4·019	19
20	·4815	3·432	·5000	3·636	·5185	3·852	·5370	4·080	·5556	4·321	20
21	·5000	3·722	·5185	3·932	·5370	4·154	·5556	4·389	·5741	4·636	21
22	·5185	4·025	·5370	4·241	·5556	4·469	·5741	4·710	·5926	4·963	22
23	·5370	4·340	·5556	4·562	·5741	4·796	·5926	5·043	·6111	5·302	23
24	·5556	4·667	·5741	4·895	·5926	5·136	·6111	5·389	·6296	5·654	24
25	·5741	5·006	·5926	5·241	·6111	5·488	·6296	5·747	·6481	6·019	25
26	·5926	5·358	·6111	5·599	·6296	5·852	·6481	6·117	·6667	6·395	26
27	·6111	5·722	·6296	5·969	·6481	6·228	·6667	6·500	·6852	6·784	27
28	·6296	6·099	·6481	6·352	·6667	6·617	·6852	6·895	·7037	7·185	28
29	·6481	6·488	·6667	6·747	·6852	7·019	·7037	7·302	·7222	7·599	29
30	·6667	6·889	·6852	7·154	·7037	7·432	·7222	7·722	·7407	8·025	30
31	·6852	7·302	·7037	7·574	·7222	7·858	·7407	8·154	·7593	8·463	31
32	·7037	7·728	·7222	8·006	·7407	8·296	·7593	8·599	·7778	8·914	32
33	·7222	8·167	·7407	8·451	·7593	8·747	·7778	9·056	·7963	9·377	33
34	·7407	8·617	·7593	8·907	·7778	9·210	·7963	9·525	·8148	9·852	34
35	·7593	9·080	·7778	9·377	·7963	9·685	·8148	10·006	·8333	10·340	35
36	·7778	9·556	·7963	9·858	·8148	10·173	·8333	10·500	·8519	10·840	36
37	·7963	10·043	·8148	10·352	·8333	10·673	·8519	11·006	·8704	11·352	37
38	·8148	10·543	·8333	10·858	·8519	11·185	·8704	11·525	·8889	11·877	38
39	·8333	11·056	·8519	11·377	·8704	11·710	·8889	12·056	·9074	12·414	39
40	·8519	11·580	·8704	11·907	·8889	12·247	·9074	12·599	·9259	12·963	40

TABLE XIX.—BASE 1.—SLOPES ½ to 1.

Feet.	11		12		13		14		15		Feet.
	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	
0	·2037	·747	·2222	·889	·2407	1·043	·2593	1·210	·2778	1·389	0
1	·2222	·821	·2407	·969	·2593	1·130	·2778	1·302	·2963	1·488	1
2	·2407	·907	·2593	1·062	·2778	1·228	·2963	1·407	·3148	1·599	2
3	·2593	1·006	·2778	1·167	·2963	1·340	·3148	1·525	·3333	1·722	3
4	·2778	1·117	·2963	1·284	·3148	1·463	·3333	1·654	·3519	1·858	4
5	·2963	1·241	·3148	1·414	·3333	1·599	·3519	1·796	·3704	2·006	5
6	·3148	1·377	·3333	1·556	·3519	1·747	·3704	1·951	·3889	2·167	6
7	·3333	1·525	·3519	1·710	·3704	1·907	·3889	2·117	·4074	2·340	7
8	·3519	1·685	·3704	1·877	·3889	2·080	·4074	2·296	·4259	2·525	8
9	·3704	1·858	·3889	2·056	·4074	2·265	·4259	2·488	·4444	2·722	9
10	·3889	2·043	·4074	2·247	·4259	2·463	·4444	2·691	·4630	2·932	10
11	·4074	2·241	·4259	2·451	·4444	2·673	·4630	2·907	·4815	3·154	11
12	·4259	2·451	·4444	2·667	·4630	2·895	·4815	3·136	·5000	3·389	12
13	·4444	2·673	·4630	2·895	·4815	3·130	·5000	3·377	·5185	3·636	13
14	·4630	2·907	·4815	3·136	·5000	3·377	·5185	3·630	·5370	3·895	14
15	·4815	3·154	·5000	3·389	·5185	3·636	·5370	3·895	·5556	4·167	15
16	·5000	3·414	·5185	3·654	·5370	3·907	·5556	4·173	·5741	4·451	16
17	·5185	3·685	·5370	3·932	·5556	4·191	·5741	4·463	·5926	4·747	17
18	·5370	3·969	·5556	4·222	·5741	4·488	·5926	4·765	·6111	5·056	18
19	·5556	4·265	·5741	4·525	·5926	4·796	·6111	5·080	·6296	5·377	19
20	·5741	4·574	·5926	4·840	·6111	5·117	·6296	5·407	·6481	5·710	20
21	·5926	4·895	·6111	5·167	·6296	5·451	·6481	5·747	·6667	6·056	21
22	·6111	5·228	·6296	5·506	·6481	5·796	·6667	6·099	·6852	6·414	22
23	·6296	5·574	·6481	5·858	·6667	6·154	·6852	6·463	·7037	6·784	23
24	·6481	5·932	·6667	6·222	·6852	6·525	·7037	6·840	·7222	7·167	24
25	·6667	6·302	·6852	6·599	·7037	6·907	·7222	7·228	·7407	7·562	25
26	·6852	6·685	·7037	6·988	·7222	7·302	·7407	7·630	·7593	7·969	26
27	·7037	7·080	·7222	7·389	·7407	7·710	·7593	8·043	·7778	8·389	27
28	·7222	7·488	·7407	7·802	·7593	8·130	·7778	8·469	·7963	8·821	28
29	·7407	7·907	·7593	8·228	·7778	8·562	·7963	8·907	·8148	9·265	29
30	·7593	8·340	·7778	8·667	·7963	9·006	·8148	9·358	·8333	9·722	30
31	·7778	8·784	·7963	9·117	·8148	9·463	·8333	9·821	·8519	10·191	31
32	·7963	9·241	·8148	9·580	·8333	9·932	·8519	10·296	·8704	10·673	32
33	·8148	9·710	·8333	10·056	·8519	10·414	·8704	10·784	·8889	11·167	33
34	·8333	10·191	·8519	10·543	·8704	10·907	·8889	11·284	·9074	11·673	34
35	·8519	10·685	·8704	11·043	·8889	11·414	·9074	11·796	·9259	12·191	35
36	·8704	11·191	·8889	11·556	·9074	11·932	·9259	12·321	·9444	12·722	36
37	·8889	11·710	·9074	12·080	·9259	12·463	·9444	12·858	·9630	13·265	37
38	·9074	12·241	·9259	12·617	·9444	13·006	·9630	13·407	·9815	13·821	38
39	·9259	12·784	·9444	13·167	·9630	13·562	·9815	13·969	1·0000	14·389	39
40	·9444	13·340	·9630	13·728	·9815	14·130	1·0000	14·543	1·0185	14·969	40

TABLE XX.—BASE 1.—SLOPES ½ to 1.

Feet.	16		17		18		19		20		Feet.
	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	
0	·2963	1·580	·3148	1·784	·3333	2·000	·3519	2·228	·3704	2·469	0
1	·3148	1·685	·3333	1·895	·3519	2·117	·3704	2·352	·3889	2·599	1
2	·3333	1·802	·3519	2·019	·3704	2·247	·3889	2·488	·4074	2·741	2
3	·3519	1·932	·3704	2·154	·3889	2·389	·4074	2·636	·4259	2·895	3
4	·3704	2·074	·3889	2·302	·4074	2·543	·4259	2·796	·4444	3·062	4
5	·3889	2·228	·4074	2·463	·4259	2·710	·4444	2·969	·4630	3·241	5
6	·4074	2·395	·4259	2·636	·4444	2·889	·4630	3·154	·4815	3·432	6
7	·4259	2·574	·4444	2·821	·4630	3·080	·4815	3·352	·5000	3·636	7
8	·4444	2·765	·4630	3·019	·4815	3·284	·5000	3·562	·5185	3·852	8
9	·4630	2·969	·4815	3·228	·5000	3·500	·5185	3·784	·5370	4·080	9
10	·4815	3·185	·5000	3·451	·5185	3·728	·5370	4·019	·5556	4·321	10
11	·5000	3·414	·5185	3·685	·5370	3·969	·5556	4·265	·5741	4·574	11
12	·5185	3·654	·5370	3·932	·5556	4·222	·5741	4·525	·5926	4·840	12
13	·5370	3·907	·5556	4·191	·5741	4·488	·5926	4·796	·6111	5·117	13
14	·5556	4·173	·5741	4·463	·5926	4·765	·6111	5·080	·6296	5·407	14
15	·5741	4·451	·5926	4·747	·6111	5·056	·6296	5·377	·6481	5·710	15
16	·5926	4·741	·6111	5·043	·6296	5·358	·6481	5·685	·6667	6·025	16
17	·6111	5·043	·6296	5·352	·6481	5·673	·6667	6·006	·6852	6·352	17
18	·6296	5·358	·6481	5·673	·6667	6·000	·6852	6·340	·7037	6·691	18
19	·6481	5·685	·6667	6·006	·6852	6·340	·7037	6·685	·7222	7·043	19
20	·6667	6·025	·6852	6·352	·7037	6·691	·7222	7·043	·7407	7·407	20
21	·6852	6·377	·7037	6·710	·7222	7·056	·7407	7·414	·7593	7·784	21
22	·7037	6·741	·7222	7·080	·7407	7·432	·7593	7·796	·7778	8·173	22
23	·7222	7·117	·7407	7·463	·7593	7·821	·7778	8·191	·7963	8·574	23
24	·7407	7·506	·7593	7·858	·7778	8·222	·7963	8·599	·8148	8·988	24
25	·7593	7·907	·7778	8·265	·7963	8·636	·8148	9·019	·8333	9·414	25
26	·7778	8·321	·7963	8·685	·8148	9·062	·8333	9·451	·8519	9·852	26
27	·7963	8·747	·8148	9·117	·8333	9·500	·8519	9·895	·8704	10·302	27
28	·8148	9·185	·8333	9·562	·8519	9·951	·8704	10·352	·8889	10·765	28
29	·8333	9·636	·8519	10·019	·8704	10·414	·8889	10·821	·9074	11·241	29
30	·8519	10·099	·8704	10·488	·8889	10·889	·9074	11·302	·9259	11·728	30
31	·8704	10·574	·8889	10·969	·9074	11·377	·9259	11·796	·9444	12·228	31
32	·8889	11·062	·9074	11·463	·9259	11·877	·9444	12·302	·9630	12·741	32
33	·9074	11·562	·9259	11·969	·9444	12·389	·9630	12·821	·9815	13·265	33
34	·9259	12·074	·9444	12·488	·9630	12·914	·9815	13·352	1·0000	13·803	34
35	·9444	12·599	·9630	13·019	·9815	13·451	1·0000	13·895	1·0185	14·352	35
36	·9630	13·136	·9815	13·562	1·0000	14·000	1·0185	14·451	1·0370	14·914	36
37	·9815	13·685	1·0000	14·117	1·0185	14·562	1·0370	15·019	1·0556	15·488	37
38	1·0000	14·247	1·0185	14·685	1·0370	15·136	1·0556	15·599	1·0741	16·074	38
39	1·0185	14·821	1·0370	15·265	1·0556	15·722	1·0741	16·191	1·0926	16·673	39
40	1·0370	15·407	1·0556	15·858	1·0741	16·321	1·0926	16·796	1·1111	17·284	40

TABLE XXI.—BASE 1.—SLOPES ½ to 1.

Feet.	21		22		23		24		25		Feet.
	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	
0	·3889	2·722	·4074	2·988	·4259	3·265	·4444	3·556	·4630	3·858	0
1	·4074	2·858	·4259	3·130	·4444	3·414	·4630	3·710	·4815	4·019	1
2	·4259	3·006	·4444	3·284	·4630	3·574	·4815	3·877	·5000	4·191	2
3	·4444	3·167	·4630	3·451	·4815	3·747	·5000	4·056	·5185	4·377	3
4	·4630	3·340	·4815	3·630	·5000	3·932	·5185	4·247	·5370	4·574	4
5	·4815	3·525	·5000	3·821	·5185	4·130	·5370	4·451	·5556	4·784	5
6	·5000	3·722	·5185	4·025	·5370	4·340	·5556	4·667	·5741	5·006	6
7	·5185	3·932	·5370	4·241	·5556	4·562	·5741	4·895	·5926	5·241	7
8	·5370	4·154	·5556	4·469	·5741	4·796	·5926	5·136	·6111	5·488	8
9	·5556	4·389	·5741	4·710	·5926	5·043	·6111	5·389	·6296	5·747	9
10	·5741	4·636	·5926	4·963	·6111	5·302	·6296	5·654	·6481	6·019	10
11	·5926	4·895	·6111	5·228	·6296	5·574	·6481	5·932	·6667	6·302	11
12	·6111	5·167	·6296	5·506	·6481	5·858	·6667	6·222	·6852	6·599	12
13	·6296	5·451	·6481	5·796	·6667	6·154	·6852	6·525	·7037	6·907	13
14	·6481	5·747	·6667	6·099	·6852	6·463	·7037	6·840	·7222	7·228	14
15	·6667	6·056	·6852	6·414	·7037	6·784	·7222	7·167	·7407	7·562	15
16	·6852	6·377	·7037	6·741	·7222	7·117	·7407	7·506	·7593	7·907	16
17	·7037	6·710	·7222	7·080	·7407	7·463	·7593	7·858	·7778	8·265	17
18	·7222	7·056	·7407	7·432	·7593	7·821	·7778	8·222	·7963	8·636	18
19	·7407	7·414	·7593	7·796	·7778	8·191	·7963	8·599	·8148	9·019	19
20	·7593	7·784	·7778	8·173	·7963	8·574	·8148	8·988	·8333	9·414	20
21	·7778	8·167	·7963	8·562	·8148	8·969	·8333	9·389	·8519	9·821	21
22	·7963	8·562	·8148	8·963	·8333	9·377	·8519	9·802	·8704	10·241	22
23	·8148	8·969	·8333	9·377	·8519	9·796	·8704	10·228	·8889	10·673	23
24	·8333	9·389	·8519	9·802	·8704	10·228	·8889	10·667	·9074	11·117	24
25	·8519	9·821	·8704	10·241	·8889	10·673	·9074	11·117	·9259	11·574	25
26	·8704	10·265	·8889	10·691	·9074	11·130	·9259	11·580	·9444	12·043	26
27	·8889	10·722	·9074	11·154	·9259	11·599	·9444	12·056	·9630	12·525	27
28	·9074	11·191	·9259	11·630	·9444	12·080	·9630	12·543	·9815	13·019	28
29	·9259	11·673	·9444	12·117	·9630	12·574	·9815	13·043	1·0000	13·525	29
30	·9444	12·167	·9630	12·617	·9815	13·080	1·0000	13·556	1·0185	14·043	30
31	·9630	12·673	·9815	13·130	1·0000	13·599	1·0185	14·080	1·0370	14·574	31
32	·9815	13·191	1·0000	13·654	1·0185	14·130	1·0370	14·617	1·0556	15·117	32
33	1·0000	13·722	1·0185	14·191	1·0370	14·673	1·0556	15·167	1·0741	15·673	33
34	1·0185	14·265	1·0370	14·741	1·0556	15·228	1·0741	15·728	1·0926	16·241	34
35	1·0370	14·821	1·0556	15·302	1·0741	15·796	1·0926	16·302	1·1111	16·821	35
36	1·0556	15·389	1·0741	15·877	1·0926	16·377	1·1111	16·889	1·1296	17·414	36
37	1·0741	15·969	1·0926	16·463	1·1111	16·969	1·1296	17·488	1·1481	18·019	37
38	1·0926	16·562	1·1111	17·062	1·1296	17·574	1·1481	18·099	1·1667	18·636	38
39	1·1111	17·167	1·1296	17·673	1·1481	18·191	1·1667	18·722	1·1852	19·265	39
40	1·1296	17·784	1·1481	18·296	1·1667	18·821	1·1852	19·358	1·2047	19·907	40

TABLE XXII.—BASE 1.—SLOPES ½ to 1.

Feet.	26		27		28		29		30		Feet.
	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	
0	·4815	4·173	·5000	4·500	·5185	4·840	·5370	5·191	·5556	5·556	0
1	·5000	4·340	·5185	4·673	·5370	5·019	·5556	5·377	·5741	5·747	1
2	·5185	4·519	·5370	4·858	·5556	5·210	·5741	5·574	·5926	5·951	2
3	·5370	4·710	·5556	5·056	·5741	5·414	·5926	5·784	·6111	6·167	3
4	·5556	4·914	·5741	5·265	·5926	5·630	·6111	6·006	·6296	6·395	4
5	·5741	5·130	·5926	5·488	·6111	5·858	·6296	6·241	·6481	6·636	5
6	·5926	5·358	·6111	5·722	·6296	6·099	·6481	6·488	·6667	6·889	6
7	·6111	5·599	·6296	5·969	·6481	6·352	·6667	6·747	·6852	7·154	7
8	·6296	5·852	·6481	6·228	·6667	6·617	·6852	7·019	·7037	7·432	8
9	·6481	6·117	·6667	6·500	·6852	6·895	·7037	7·302	·7222	7·722	9
10	·6667	6·395	·6852	6·784	·7037	7·185	·7222	7·599	·7407	8·025	10
11	·6852	6·685	·7037	7·080	·7222	7·488	·7407	7·907	·7593	8·340	11
12	·7037	6·988	·7222	7·389	·7407	7·802	·7593	8·228	·7778	8·667	12
13	·7222	7·302	·7407	7·710	·7593	8·130	·7778	8·562	·7963	9·006	13
14	·7407	7·630	·7593	8·043	·7778	8·469	·7963	8·907	·8148	9·358	14
15	·7593	7·969	·7778	8·389	·7963	8·821	·8148	9·265	·8333	9·722	15
16	·7778	8·321	·7963	8·747	·8148	9·185	·8333	9·636	·8519	10·099	16
17	·7963	8·685	·8148	9·117	·8333	9·562	·8519	10·019	·8704	10·488	17
18	·8148	9·062	·8333	9·500	·8519	9·951	·8704	10·414	·8889	10·889	18
19	·8333	9·451	·8519	9·895	·8704	10·352	·8889	10·821	·9074	11·302	19
20	·8519	9·852	·8704	10·302	·8889	10·765	·9074	11·241	·9259	11·728	20
21	·8704	10·265	·8889	10·722	·9074	11·191	.9259	11·673	·9444	12·167	21
22	·8889	10·691	·9074	11·154	·9259	11·630	·9444	12·117	·9630	12·617	22
23	·9074	11·130	·9259	11·599	·9444	12·080	·9630	12·574	·9815	13·080	23
24	·9259	11·580	·9444	12·056	·9630	12·543	·9815	13·043	1·0000	13·556	24
25	·9444	12·043	·9630	12·525	·9815	13·019	1·0000	13·525	1·0185	14·043	25
26	·9630	12·519	·9815	13·006	1·0000	13·506	1·0185	14·019	1·0370	14·543	26
27	·9815	13·006	1·0000	13·500	1·0185	14·006	1·0370	14·525	1·0556	15·056	27
28	1·0000	13·506	1·0185	14·006	1.0370	14·519	1·0556	15·043	1·0741	15·580	28
29	1·0185	14·019	1·0370	14·525	1·0556	15·043	1·0741	15·574	1·0926	16·117	29
30	1·0370	14·543	1·0556	15·056	1.0741	15·580	1·0926	16·117	1·1111	16·667	30
31	1·0556	15·080	1·0741	15·599	1·0926	16·130	1·1111	16·673	1·1296	17·228	31
32	1·0741	15·630	1·0926	16·154	1·1111	16·691	1·1296	17·241	1·1481	17·802	32
33	1·0926	16·191	1·1111	16·722	1·1296	17·265	1·1481	17·821	1·1667	18·389	33
34	1·1111	16·765	1·1296	17·302	1·1481	17·852	1·1667	18·414	1·1852	18·988	34
35	1·1296	17·352	1·1481	17·895	1·1667	18·451	1·1852	19·019	1·2047	19·599	35
36	1·1481	17·951	1·1667	18·500	1·1852	19·062	1·2047	19·636	1·2222	20·222	36
37	1·1667	18·562	1·1852	19·117	1·2047	19·685	1·2222	20·265	1·2407	20·858	37
38	1.1852	19·185	1·2047	19·747	1·2222	20·321	1·2407	20·907	1·2593	21·506	38
39	1·2047	19·821	1·2222	20·389	1·2407	20·969	1·2593	21·562	1·2778	22·167	39
40	1·2222	20·469	1·2407	21·043	1·2593	21·630	1·2778	22·228	1·2963	22·840	40

TABLE XXIII.—BASE 1.—SLOPES ½ to 1.

Feet.	31		32		33		34		35		Feet.
	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	
0	·5741	5·932	·5926	6·321	·6111	6·722	·6296	7·136	·6481	7·562	0
1	·5926	6·130	·6111	6·525	·6296	6·932	·6481	7·352	·6667	7·784	1
2	·6111	6·340	·6296	6·741	·6481	7·154	·6667	7·580	·6852	8·019	2
3	·6296	6·562	·6481	6·969	·6667	7·389	·6852	7·821	·7037	8·265	3
4	·6481	6·796	·6667	7·210	·6852	7·636	·7037	8·074	·7222	8·525	4
5	·6667	7·043	·6852	7·463	·7037	7·895	·7222	8·340	·7407	8·796	5
6	·6852	7·302	·7037	7·728	·7222	8·167	·7407	8·617	·7593	9·080	6
7	·7037	7·574	·7222	8·006	·7407	8·451	·7593	8·907	·7778	9·377	7
8	·7222	7·858	·7407	8·296	·7593	8·747	·7778	9·210	·7963	9·685	8
9	·7407	8·154	·7593	8·599	·7778	9·056	·7963	9·525	·8148	10·006	9
10	·7593	8·463	·7778	8·914	·7963	9·377	·8148	9·852	·8333	10·340	10
11	·7778	8·784	·7963	9·241	·8148	9·710	·8333	10·191	·8519	10·685	11
12	·7963	9·117	·8148	9·580	·8333	10·056	·8519	10·543	·8704	11·043	12
13	·8148	9·463	·8333	9·932	·8519	10·414	·8704	10·907	·8889	11·414	13
14	·8333	9·821	·8519	10·296	·8704	10·784	·8889	11·284	·9074	11·796	14
15	·8519	10·191	·8704	10·673	·8889	11·167	·9074	11·673	·9259	12·191	15
16	·8704	10·574	·8889	11·062	·9074	11·562	·9259	12·074	·9444	12·599	16
17	·8889	10·969	·9074	11·463	·9259	11·969	·9444	12·488	·9630	13·019	17
18	·9074	11·377	·9259	11·877	·9444	12·389	·9630	12·914	·9815	13·451	18
19	·9259	11·796	·9444	12·302	·9630	12·821	·9815	13·352	1·0000	13·895	19
20	·9444	12·228	·9630	12·741	·9815	13·265	1·0000	13·803	1·0185	14·352	20
21	·9630	12·673	·9815	13·191	1·0000	13·722	1·0185	14·265	1·0370	14·821	21
22	·9815	13·130	1·0000	13·654	1·0185	14·191	1·0370	14·741	1·0556	15·302	22
23	1·0000	13·599	1·0185	14·130	1·0370	14·673	1·0556	15·228	1 0741	15·796	23
24	1·0185	14·080	1·0370	14·617	1·0556	15·167	1·0741	15·728	1·0926	16·302	24
25	1·0370	14·574	1·0556	15·117	1·0741	15·673	1·0926	16·241	1·1111	16·821	25
26	1·0556	15·080	1·0741	15·630	1·0926	16·191	1·1111	16·765	1·1296	17·352	26
27	1·0741	15·599	1·0926	16·154	1·1111	16·722	1·1296	17·302	1·1481	17·895	27
28	1·0926	16·130	1·1111	16·691	1·1296	17·265	1.1481	17·852	1·1667	18·451	28
29	1·1111	16·673	1·1296	17·241	1·1481	17·821	1·1667	18·414	1·1852	19·019	29
30	1·1296	17·228	1·1481	17·802	1·1667	18·389	1·1852	18 988	1·2047	19·599	30
31	1·1481	17·796	1·1667	18·377	1·1852	18·969	1·2047	19·574	1·2222	20·191	31
32	1·1667	18·377	1·1852	18·963	1·2047	19·562	1·2222	20·173	1·2407	20·796	32
33	1·1852	18·969	1·2047	19·562	1·2222	20·167	1·2407	20·784	1·2593	21·414	33
34	1·2047	19·574	1·2222	20·173	1·2407	20·784	1·2593	21·407	1·2778	22·043	34
35	1·2222	20·191	1·2407	20·796	1·2593	21·414	1·2778	22·043	1·2963	22·685	35
36	1·2407	20·821	1·2593	21·432	1·2778	22·056	1·2963	22·691	1·3148	23·340	36
37	1·2593	21·463	1·2778	22·080	1·2963	22·710	1·3148	23·352	1·3333	24·006	37
38	1·2778	22·117	1·2963	22·741	1·3148	23·377	1·3333	24·025	1·3519	24·685	38
39	1·2963	22·784	1·3148	23·414	1·3333	24·056	1·3519	24·710	1·3704	25·377	39
40	1·3148	23·463	1·3333	24·099	1·3519	24·747	1·3704	25·407	1·3889	26·080	40

TABLE XXIV.—BASE 1.—SLOPES ½ to 1.

Feet.	36		37		38		39		40		Feet.
	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	
0	·6667	8·000	·6852	8·451	·7037	8·914	·7222	9·389	·7407	9·877	0
1	·6852	8·228	·7037	8·685	·7222	9·154	·7407	9·636	·7593	10·130	1
2	·7037	8·469	·7222	8·932	·7407	9·407	·7593	9·895	·7778	10·395	2
3	·7222	8·722	·7407	9·191	·7593	9·673	·7778	10·167	·7963	10·673	3
4	·7407	8·988	·7593	9·463	·7778	9·951	·7963	10·451	·8148	10·963	4
5	·7593	9·265	·7778	9·747	·7963	10·241	·8148	10·747	·8333	11·265	5
6	·7778	9·556	·7963	10·043	·8148	10·543	·8333	11·056	·8519	11·580	6
7	·7963	9·858	·8148	10·352	·8333	10·858	·8519	11·377	·8704	11·907	7
8	·8148	10·173	·8333	10·673	·8519	11·185	·8704	11·710	·8889	12·247	8
9	·8333	10·500	·8519	11·006	·8704	11·525	·8889	12·056	·9074	12·599	9
10	·8519	10·840	·8704	11·352	·8889	11·877	·9074	12·414	·9259	12·963	10
11	·8704	11·191	·8889	11·710	·9074	12·241	·9259	12·784	·9444	13·340	11
12	·8889	11·556	·9074	12·080	·9259	12·617	·9444	13·167	·9630	13·728	12
13	·9074	11·932	·9259	12·463	·9444	13·006	·9630	13·562	·9815	14·130	13
14	·9259	12·321	·9444	12·858	·9630	13·407	·9815	13·969	1·0000	14·543	14
15	·9444	12·722	·9630	13·265	·9815	13·821	1·0000	14·389	1·0185	14·969	15
16	·9630	13·136	·9815	13·685	1·0000	14·247	1·0185	14·821	1·0370	15·407	16
17	·9815	13·562	1·0000	14·117	1·0185	14·685	1·0370	15·265	1·0556	15·858	17
18	1·0000	14·000	1·0185	14·562	1·0370	15·136	1·0556	15·722	1·0741	16·321	18
19	1·0185	14·451	1·0370	15·019	1·0556	15·599	1·0741	16·191	1·0926	16·796	19
20	1·0370	14·914	1·0556	15·488	1·0741	16·074	1·0926	16·673	1·1111	17·284	20
21	1·0556	15·389	1·0741	15·969	1·0926	16·562	1·1111	17·167	1·1296	17·784	21
22	1·0741	15·877	1·0926	16·463	1·1111	17·062	1·1296	17·673	1·1481	18·296	22
23	1·0926	16·377	1·1111	16·969	1·1296	17·574	1·1481	18·191	1·1667	18·821	23
24	1·1111	16·889	1·1296	17·488	1·1481	18·099	1·1667	18·722	1·1852	19·358	24
25	1·1296	17·414	1·1481	18·019	1·1667	18·636	1·1852	19·265	1·2047	19·907	25
26	1·1481	17·951	1·1667	18·562	1·1852	19·185	1·2047	19·821	1·2222	20·469	26
27	1·1667	18·500	1·1852	19·117	1·2047	19·747	1·2222	20·389	1·2407	21·043	27
28	1·1852	19·062	1·2047	19·685	1·2222	20·321	1·2407	20·969	1·2593	21·630	28
29	1·2047	19·636	1·2222	20·265	1·2407	20·907	1·2593	21·562	1·2778	22·228	29
30	1·2222	20·222	1·2407	20·858	1·2593	21·506	1·2778	22·167	1·2963	22·840	30
31	1·2407	20·821	1·2593	21·463	1·2778	22·117	1·2963	22·784	1·3148	23·463	31
32	1·2593	21·432	1·2778	22·080	1·2963	22·741	1·3148	23·414	1·3333	24·099	32
33	1·2778	22·056	1·2963	22·710	1·3148	23·377	1·3333	24·056	1·3519	24·747	33
34	1·2963	22·691	1·3148	23·352	1·3333	24·025	1·3519	24·710	1·3704	25·407	34
35	1·3148	23·340	1·3333	24·006	1·3519	24·685	1·3704	25·377	1·3889	26·080	35
36	1·3333	24·000	1·3519	24·673	1·3704	25·358	1·3889	26·056	1·4074	26·765	36
37	1·3519	24·673	1·3704	25·352	1·3889	26·043	1·4074	26·747	1·4259	27·463	37
38	1·3704	25·358	1·3889	26·043	1·4074	26·741	1·4259	27·451	1·4444	28·173	38
39	1·3889	26·056	1·4074	26·747	1·4259	27·451	1·4444	28·167	1·4630	28·895	39
40	1·4074	26·765	1·4259	27·463	1·4444	28·173	1·4630	28·895	1·4815	29·630	40

TABLE XXV.—BASE 1.—SLOPES 1 to 1.

Feet.	1		2		3		4		5		Feet.
	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	
0	·0185	·012	·0370	·049	·0556	·111	·0741	·198	·0926	·308	0
1	·0370	·037	·0556	·086	·0741	·160	·0926	·259	·1111	·383	1
2	·0556	·086	·0741	·148	·0926	·235	·1111	·346	·1296	·481	2
3	·0741	·160	·0926	·235	·1111	·333	·1296	·457	·1481	·605	3
4	·0926	·259	·1111	·346	·1296	·457	·1481	·593	·1667	·753	4
5	·1111	·383	·1296	·481	·1481	·605	·1667	·753	·1852	·926	5
6	·1296	·531	·1481	·642	·1667	·778	·1852	·938	·2037	1·123	6
7	·1481	·704	·1667	·827	·1852	·975	·2037	1·148	·2222	1·346	7
8	·1667	·901	·1852	1·037	·2037	1·296	·2222	1·383	·2407	1·593	8
9	·1852	1·123	·2037	1·272	·2222	1·444	·2407	1·642	·2593	1·864	9
10	·2037	1·370	·2222	1·531	·2407	1·716	·2593	1·926	·2778	2·160	10
11	·2222	1·642	·2407	1·815	·2593	2·012	·2778	2·235	·2963	2·481	11
12	·2407	1·938	·2593	2·123	·2778	2·333	·2963	2·568	·3148	2·827	12
13	·2593	2·259	·2778	2·457	·2963	2·679	·3148	2·926	·3333	3·198	13
14	·2778	2·605	·2963	2·815	·3148	3·049	·3333	3·309	·3519	3·593	14
15	·2963	2·975	·3148	3·198	·3333	3·444	·3519	3·716	·3704	4·012	15
16	·3148	3·370	·3333	3·605	·3519	3·864	·3704	4·148	·3889	4·457	16
17	·3333	3·790	·3519	4·037	·3704	4·309	·3889	4·605	·4074	4·926	17
18	·3519	4·235	·3704	4·494	·3889	4·778	·4074	5·086	·4259	5·420	18
19	·3704	4·704	·3889	4·975	·4074	5·272	·4259	5·593	·4444	5·938	19
20	·3889	5·198	·4074	5·481	·4259	5·790	·4444	6·061	·4630	6·481	20
21	·4074	5·716	·4259	6·012	·4444	6·333	·4630	6·679	·4815	7·049	21
22	·4259	6·259	·4444	6·568	·4630	6·901	·4815	7·259	·5000	7·642	22
23	·4444	6·827	·4630	7·148	·4815	7·494	·5000	7·864	·5185	8·259	23
24	·4630	7·420	·4815	7·753	·5000	8·111	·5185	8·494	·5370	8·901	24
25	·4815	8·037	·5000	8·383	·5185	8·573	·5370	9·148	·5556	9·568	25
26	·5000	8·679	·5185	9·037	·5370	9·420	·5556	9·827	·5741	10·259	26
27	·5185	9·346	·5370	9·716	·5556	10·111	·5741	10·531	·5926	10·975	27
28	·5370	10·037	·5556	10·420	·5741	10·827	·5926	11·259	·6111	11·716	28
29	·5556	10·753	·5741	11·148	·5926	11·568	·6111	12·012	·6296	12·481	29
30	·5741	11·494	·5926	11·901	·6111	12·333	·6296	12·790	·6481	13·272	30
31	·5926	12·259	·6111	12·679	·6296	13·123	·6481	13·593	·6667	14·086	31
32	·6111	13·049	·6296	13·481	·6481	13·938	·6667	14·420	·6852	14·926	32
33	·6296	13·864	·6481	14·309	·6667	14·778	·6852	15·272	·7037	15·790	33
34	·6481	14·704	·6667	15·160	·6852	15·642	·7037	16·148	·7222	16·679	34
35	·6667	15·568	·6852	16·037	·7037	16·531	·7222	17·049	·7407	17.593	35
36	·6852	16·457	·7037	16·938	·7222	17·444	·7407	17·975	·7593	18·531	36
37	·7037	17·370	·7222	17·864	·7407	18·383	·7593	18·926	·7778	19·494	37
38	·7222	18·309	·7407	18·815	·7593	19·346	·7778	19·901	·7963	20·481	38
39	·7407	19·272	·7593	19·790	·7778	20·333	·7963	20·901	·8148	21·494	39
40	·7593	20·259	·7778	20·790	·7963	21·346	·8148	21·926	·8333	22·531	40

TABLE XXVI.—BASE 1.—SLOPES 1 to 1.

Feet.	6		7		8		9		10		Feet.
	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	
0	·1111	·444	·1296	·605	·1481	·790	·1667	1·000	·1852	1·235	0
1	·1296	·531	·1481	·704	·1667	·901	·1852	1·123	·2037	1·370	1
2	·1481	·642	·1667	·827	·1852	1·037	·2037	1·272	·2222	1·531	2
3	·1667	·778	·1852	·975	·2037	1·198	·2222	1·444	·2407	1·716	3
4	·1852	·938	·2037	1·148	·2222	1·383	·2407	1·642	·2593	1·926	4
5	·2037	1·123	·2222	1·346	·2407	1·593	·2593	1·864	·2778	2·160	5
6	·2222	1·333	·2407	1·568	·2593	1·827	·2778	2·111	·2963	2·420	6
7	·2407	1·568	·2593	1·815	·2778	2·086	·2963	2·383	·3148	2·704	7
8	·2593	1·827	·2778	2·086	·2963	2·370	·3148	2·679	·3333	3·012	8
9	·2778	2·111	·2963	2·383	·3148	2·679	·3333	3·000	·3519	3·346	9
10	·2963	2·420	·3148	2·704	·3333	3·012	·3590	3·346	·3704	3·704	10
11	·3148	2·753	·3333	3·049	·3519	3·370	·3704	3·716	·3889	4·086	11
12	·3333	3·111	·3519	3·420	·3704	3·553	·3889	4·111	·4074	4·494	12
13	·3519	3·494	·3704	3·815	·3889	4·160	·4074	4·531	·4259	4·926	13
14	.3704	3·901	·3889	4·235	·4074	4·593	·4259	4·975	·4444	5·383	14
15	·3889	4·333	·4074	4·679	·4259	5 049	·4444	5·444	·4630	5·864	15
16	·4074	4·790	·4259	5·148	·4444	5·531	·4630	5·938	·4815	6·370	16
17	·4259	5·272	·4444	5·642	·4630	6·037	·4815	6·457	·5000	6·901	17
18	·4444	5·778	·4630	6·160	·4815	6·568	·5000	7·000	·5185	7·457	18
19	·4630	6·309	·4815	6·704	·5000	7·123	·5185	7·568	·5370	8·037	19
20	·4815	6·864	·5000	7·272	·5185	7·704	·5370	8·160	·5556	8·642	20
21	·5000	7·444	·5185	7·864	·5370	8·309	·5556	8·778	·5741	9·272	21
22	·5185	8·049	·5370	8·481	·5556	8·938	·5741	9·420	·5926	9·926	22
23	·5370	8·679	·5556	9·123	·5741	9·593	·5926	10·086	·6111	10·605	23
24	·5556	9·333	·5741	9·790	·5926	10·272	·6111	10·778	·6296	11·309	24
25	·5741	10·012	·5926	10·481	·6111	10·975	·6296	11·494	·6481	12·037	25
26	·5926	10·716	·6111	11·198	·6296	11·704	·6481	12·235	·6667	12·790	26
27	·6111	11·444	·6296	11·938	·6481	12·457	·6667	13·000	·6852	13·568	27
28	·6296	12·198	·6481	12·704	·6667	13·235	·6852	13·790	·7037	14·370	28
29	·6481	12·975	·6667	13·494	·6852	14·037	·7037	14·605	·7222	15·198	29
30	·6667	13·778	·6852	14·309	·7037	14·864	·7222	15·444	·7407	16·049	30
31	·6852	14·605	·7037	15·148	·7222	15·716	·7407	16·309	·7593	16·926	31
32	·7037	15·457	·7222	16·012	·7407	16·593	·7593	17·198	·7778	17·827	32
33	·7222	16·333	·7407	16·901	·7593	17·494	·7778	18·111	·7963	18·753	33
34	·7407	17·235	·7593	17·815	·7778	18·420	·7963	19·049	·8148	19·704	34
35	·7593	18·160	·7778	18·753	·7963	19·370	·8148	20·012	·8333	20·679	35
36	·7778	19·111	·7963	19·716	·8148	20·346	·8333	21·000	·8519	21·679	36
37	·7963	20·086	·8148	20·704	·8333	21·346	·8519	22·012	·8704	22·704	37
38	·8148	21·086	·8333	21·716	·8519	22·370	·8704	23·049	·8889	23·753	38
39	·8333	22·111	·8519	22·753	·8704	23·420	·8889	24·111	·9074	24·827	39
40	·8519	23·160	·8704	23·815	·8889	24·494	·9074	25·198	·9259	25·926	40

TABLE XXVII.—BASE 1.—SLOPES 1 to 1.

Feet.	11		12		13		14		15		Feet.
	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	
0	·2037	1·494	·2222	1·778	·2407	2·086	·2593	2·420	·2778	2·778	0
1	·2222	1·642	·2407	1·938	·2593	2·259	·2778	2·605	·2963	2·975	1
2	·2407	1·815	·2593	2·123	·2778	2·457	·2963	2·815	·3148	3·198	2
3	·2593	2·012	·2778	2·333	·2963	2·679	·3148	3·049	·3333	3 444	3
4	·2778	2·235	·2963	2·568	·3148	2·926	·3333	3·309	·3519	3·716	4
5	·2963	2·481	·3148	2·827	·3333	3·198	·3519	3·593	·3704	4·012	5
6	·3148	2·753	·3333	3·111	·3519	3·494	·3704	3·901	·3889	4·333	6
7	·3333	3·049	·3519	3·420	·3704	3·815	·3889	4·235	·4074	4·679	7
8	·3519	3·370	·3704	3·753	·3889	4·161	·4074	4·593	·4259	5·049	8
9	·3704	3·716	·3889	4·111	·4074	4·531	·4259	4·975	·4444	5·444	9
10	·3889	4·086	·4074	4·494	·4259	4·926	·4444	5·383	·4630	5·864	10
11	·4074	4·481	·4259	4·901	·4444	5·346	·4630	5·815	·4815	6·309	11
12	·4259	4·901	·4444	5·333	·4630	5·790	·4815	6·272	·5000	6·778	12
13	·4444	5·346	·4630	5·790	·4815	6·259	·5000	6·753	·5185	7·272	13
14	·4630	5·815	·4815	6·272	·5000	6·753	·5185	7·259	·5370	7·790	14
15	·4815	6·309	·5000	6·778	·5185	7·272	·5370	7·790	·5556	8·333	15
16	·5000	6·827	·5185	7·309	·5370	7·815	·5556	8·346	·5741	8·901	16
17	·5185	7·370	·5370	7·864	·5556	8·383	·5741	8·926	·5926	9·494	17
18	·5370	7·938	·5556	8·444	·5741	8·975	·5926	9·531	·6111	10·111	18
19	·5556	8·531	·5741	9·049	·5926	9·593	·6111	10·160	·6296	10·753	19
20	·5741	9·148	·5926	9·679	·6111	10·235	·6296	10·815	·6481	11·420	20
21	·5926	9·790	·6111	10·333	·6296	10·901	·6481	11·494	·6667	12·111	21
22	·6111	10·457	·6296	11·012	·6481	11·593	·6667	12·198	·6852	12·827	22
23	·6296	11·148	·6481	11·716	·6667	12·309	·6852	12·926	·7037	13·568	23
24	·6481	11·864	·6667	12·444	·6852	13·049	·7037	13·679	·7222	14·333	24
25	·6667	12·605	·6852	13·198	·7037	13·815	·7222	14·457	·7407	15·123	25
26	·6852	13·370	·7037	13·975	·7222	14·605	·7407	15·259	·7593	15·938	26
27	·7037	14·160	·7222	14·778	·7407	15·420	·7593	16·086	·7778	16·778	27
28	·7222	14·975	·7407	15·605	·7593	16·259	·7778	16·938	·7963	17·642	28
29	·7407	15·815	·7593	16·457	·7778	17·123	·7963	17·815	·8148	18·531	29
30	·7593	16·679	·7778	17·333	·7963	18·012	·8148	18·716	·8333	19·444	30
31	·7778	17·568	·7963	18·235	·8148	18·926	·8333	19·642	·8519	20·383	31
32	·7963	18·481	·8148	19·160	·8333	19·864	·8519	20·593	·8704	21·346	32
33	·8148	19·420	·8333	20·111	·8519	20·827	·8704	21·568	·8889	22·333	33
34	·8333	20·383	·8519	21·086	·8704	21·815	·8889	22·568	·9074	23·346	34
35	·8519	21·370	·8704	22·086	·8889	22·827	·9074	23·593	·9259	24·383	35
36	·8704	22·383	·8889	23·111	·9074	23·864	·9259	24·642	·9444	25·444	36
37	·8889	23·420	·9074	24·160	·9259	24·926	·9444	25·716	·9630	26·531	37
38	·9074	24·481	·9259	25·235	·9444	26·012	·9630	26·815	·9815	27·642	38
39	·9259	25·568	·9444	26·333	·9630	27·123	·9815	27·938	1·0000	28·778	39
40	·9444	26·679	·9630	27·457	·9815	28·259	1·0000	29·086	1·0185	29·938	40

TABLE XXVIII.—BASE 1.—SLOPES 1 to 1.

Feet.	16		17		18		19		20		Feet.
	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	
0	·2963	3·160	·3148	3·568	·3333	4·000	·3519	4·457	·3704	4·938	0
1	·3148	3·370	·3333	3·790	·3519	4·234	·3704	4·704	·3889	5·198	1
2	·3333	3·605	·3519	4·037	·3704	4·494	·3889	4·975	·4074	5·481	2
3	·3519	3·864	·3704	4·309	·3889	4·778	·4074	5·272	·4259	5·790	3
4	·3704	4·148	·3889	4·605	·4074	5·086	·4259	5·593	·4444	6·123	4
5	·3889	4·457	·4074	4·926	·4259	5·420	·4444	5·938	·4630	6·481	5
6	·4074	4·790	·4259	5·272	·4444	5·778	·4630	6·309	·4815	6·864	6
7	·4259	5·148	·4444	5·642	·4630	6·160	·4815	6·704	·5000	7·272	7
8	·4444	5·531	·4630	6·037	·4815	6·568	·5000	7·123	·5185	7·704	8
9	·4630	5·938	·4815	6·457	·5000	7·000	·5185	7·568	·5370	8·160	9
10	·4815	6·370	·5000	6·901	·5185	7·457	·5370	8·037	·5556	8·642	10
11	·5000	6·827	·5185	7·370	·5370	7·938	·5556	8·531	·5741	9·148	11
12	·5185	7·309	·5370	7·864	·5556	8·444	·5741	9·049	·5926	9·679	12
13	·5370	7·815	·5556	8·383	·5741	8·975	·5926	9·593	·6111	10·235	13
14	·5556	8·346	·5741	8·926	·5926	9·531	·6111	10·160	·6296	10·815	14
15	·5741	8·901	·5926	9·494	·6111	10·111	·6296	10·753	·6481	11·420	15
16	·5926	9·481	·6111	10·086	·6296	10·716	·6481	11·370	·6667	12·049	16
17	·6111	10·086	·6296	10·704	·6481	11·346	·6667	12·012	·6852	12·704	17
18	·6296	10·716	·6481	11·346	·6667	12·000	·6852	12·679	·7037	13·383	18
19	·6481	11·370	·6667	12·012	·6852	12·679	·7037	13·370	·7222	14·086	19
20	·6667	12·049	·6852	12·704	·7037	13·383	·7222	14·086	·7407	14·815	20
21	·6852	12·753	·7037	13·420	·7222	14·111	·7407	14·827	·7593	15·568	21
22	·7037	13·481	·7222	14·160	·7407	14·864	·7593	15·593	·7778	16·346	22
23	·7222	14·235	·7407	14·926	·7593	15·642	·7778	16·383	·7963	17·148	23
24	·7407	15·012	·7593	15·716	·7778	16·444	·7963	17·198	·8148	17·975	24
25	·7593	15·815	·7778	16·531	·7963	17·272	·8148	18·037	·8333	18·827	25
26	·7778	16·642	·7963	17·370	·8148	18·123	·8333	18·901	·8519	19·704	26
27	·7963	17·494	·8148	18·235	·8333	19·000	·8519	19·790	·8704	20·605	27
28	·8148	18·370	·8333	19·123	·8519	19·901	·8704	20·704	·8889	21·531	28
29	·8333	19·272	·8519	20·037	·8704	20·827	·8889	21·642	·9074	22·481	29
30	·8519	20·198	·8704	20·975	·8889	21·778	·9074	22·605	·9259	23·457	30
31	·8704	21·148	·8889	21·938	·9074	22·753	·9259	23·593	·9444	24·457	31
32	·8889	22·123	·9074	22·926	·9259	23·753	·9444	24·605	·9630	25·481	32
33	·9074	23·123	·9259	23·938	·9444	24·778	·9630	25·642	·9815	26·531	33
34	·9259	24·148	·9444	24·975	·9630	25·827	·9815	26·704	1·0000	27·605	34
35	·9444	25·198	·9630	26·037	·9815	26·901	1·0000	27·790	1·0185	28·704	35
36	·9630	26·272	·9815	27·123	1·0000	28·000	1·0185	28·901	1·0370	29·827	36
37	·9815	27·370	1·0000	28·235	1·0185	29·123	1·0370	30·037	1·0556	30·975	37
38	1·0000	28·494	1·0185	29·370	1·0370	30·272	1·0556	31·198	1·0741	32·148	38
39	1·0185	29·642	1·0370	30·531	1·0556	31·444	1·0741	32·383	1·0926	33·346	39
40	1·0370	30·815	1·0556	31·716	1·0741	32·642	1·0926	33·593	1·1111	34·568	40

TABLE XXIX.—BASE 1.—SLOPES 1 to 1.

Feet.	21		22		23		24		25		Feet.
	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	
0	·3889	5·444	·4074	5·975	·4259	6·531	·4444	7·111	·4630	7·716	0
1	·4074	5·716	·4259	6·259	·4444	6·827	·4630	7·420	·4815	8·037	1
2	·4259	6·012	·4444	6·568	·4630	7·148	·4815	7·753	·5000	8·383	2
3	·4444	6·333	·4630	6·901	·4815	7·494	·5000	8·111	·5185	8·753	3
4	·4630	6·679	·4815	7·259	·5000	7·864	·5185	8·494	·5370	9·148	4
5	·4815	7·049	·5000	7·642	·5185	8·259	·5370	8·901	·5556	9·568	5
6	·5000	7·444	·5185	8·049	·5370	8·679	·5556	9·333	·5741	10·012	6
7	·5185	7·864	·5370	8·481	·5556	9·123	·5741	9·790	·5926	10·481	7
8	·5370	8·309	·5556	8·938	·5741	9·593	·5926	10·272	·6111	10·975	8
9	·5556	8·778	·5741	9·420	·5926	10·086	·6111	10·778	·6296	11·494	9
10	·5741	9·272	·5926	9·926	·6111	10·605	·6296	11·309	·6481	12·037	10
11	·5926	9·790	·6111	10·457	·6296	11·148	·6481	11·864	·6667	12·605	11
12	·6111	10·333	·6296	11·012	·6481	11·716	·6667	12·444	·6852	13·198	12
13	·6296	10·901	·6481	11·593	·6667	12·309	·6852	13·049	·7037	13·815	13
14	·6481	11·494	·6667	12·198	·6852	12·926	·7037	13·679	·7222	14·457	14
15	·6667	12·111	·6852	12·827	·7037	13·568	·7222	14·333	·7407	15·123	15
16	·6852	12·753	·7037	13·481	·7222	14·235	·7407	15·012	·7593	15·815	16
17	·7037	13·420	·7222	14·160	·7407	14·926	·7593	15·716	·7778	16·531	17
18	·7222	14·111	·7407	14·864	·7593	15·642	·7778	16·444	·7963	17·272	18
19	·7407	14·827	·7593	15·593	·7778	16·383	·7963	17·198	·8148	18·037	19
20	·7593	15·568	·7778	16·346	·7963	17·148	·8148	17·975	·8333	18·827	20
21	·7778	16·333	·7963	17·123	·8148	17·938	·8333	18·778	·8519	19·642	21
22	·7963	17·123	·8148	17·926	·8333	18·753	·8519	19·605	·8704	20·481	22
23	·8148	17·938	·8333	18·753	·8519	19·593	·8704	20·457	·8889	21·346	33
24	·8333	18·778	·8519	19·605	·8704	20·457	·8889	21·333	·9074	22·235	24
25	·8519	19·642	·8704	20·481	·8889	21·346	·9074	22·235	·9259	23·148	25
26	·8704	20·531	·8889	21·383	·9074	22·259	·9259	23·160	·9444	24·086	26
27	·8889	21·444	·9074	22·309	·9259	23·198	·9444	24·111	·9630	25·049	27
28	·9074	22·383	·9259	23·259	·9444	24·160	·9630	25·086	·9815	26·037	28
29	·9259	23·346	·9444	24·235	·9630	25·148	·9815	26·086	1·0000	27·049	29
30	·9444	24·333	·9630	25·235	·9815	26·160	1·0000	27·111	1·0185	28·086	30
31	·9630	25·346	·9815	26·259	1·0000	27·198	1·0185	28·160	1·0370	29·148	31
32	·9815	26·383	1·0000	27·309	1·0185	28·259	1·0370	29·235	1·0556	30·235	32
33	1·0000	27·444	1·0185	28·383	1·0370	29·346	1·0556	30·333	1·0741	31·346	33
34	1·0185	28·531	1·0370	29·481	1·0556	30·457	1·0741	31·457	1·0926	32·481	34
35	1·0370	29·642	1·0556	30·605	1·0741	31·593	1·0926	32·605	1·1111	33·642	35
36	1·0556	30·778	1·0741	31·753	1·0926	32·753	1·1111	33·778	1·1296	34·827	36
37	1·0741	31·938	1·0926	32·926	1·1111	33·938	1·1296	34·975	1·1481	36·037	37
38	1·0926	33·123	1·1111	34·123	1·1296	35·148	1·1481	36·198	1·1667	37·272	38
39	1·1111	34·333	1·1296	35·346	1·1481	36·383	1·1667	37·444	1·1852	38·531	39
40	1·1296	35·568	1·1481	36·593	1·1667	37·642	1·1852	38·716	1·2047	39·815	40

TABLE XXX.—BASE 1.—SLOPES 1 to 1.

Feet.	26		27		28		29		30		Feet.
	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	
0	·4815	8·346	·5000	9·000	·5185	9·679	·5370	10·383	·5556	11·111	0
1	·5000	8·679	·5185	9·346	·5370	10·037	·5556	10·753	·5741	11·494	1
2	·5185	9·037	·5370	9·716	·5556	10·420	·5741	11·148	·5926	11·901	2
3	·5370	9·420	·5556	10·111	·5741	10·827	·5926	11·568	·6111	12·333	3
4	·5556	9·827	·5741	10·531	·5926	11·259	.6111	12·012	·6296	12·790	4
5	·5741	10·259	·5926	10·975	·6111	11·716	·6296	12·481	·6481	13·272	5
6	·5926	10·716	·6111	11·444	·6296	12·198	·6481	12·975	·6667	13·778	6
7	·6111	11·198	·6296	11·938	·6481	12·704	·6667	13·494	·6852	14·309	7
8	·6296	11·704	·6481	12·457	·6667	13·235	·6852	14·037	·7037	14·864	8
9	6481	12·235	·6667	13·000	·6852	13·790	·7037	14·605	·7222	15·444	9
10	·6667	12·790	·6852	13·568	·7037	14·370	·7222	15·198	·7407	16·049	10
11	·6852	13·370	·7037	14·160	·7222	14·975	·7407	15·815	·7593	16·679	11
12	·7037	13·975	·7222	14·778	·7407	15·605	·7593	16·457	·7778	17·333	12
13	·7222	14·605	·7407	15·420	·7593	16·259	·7778	17·123	·7963	18·012	13
14	·7407	15·259	·7593	16·086	·7778	16·938	·7963	17·815	·8148	18·716	14
15	·7593	15·938	·7778	16·778	·7963	17·642	·8148	18·531	·8333	19·444	15
16	·7778	16·642	·7963	17·494	·8148	18·370	·8333	19·272	·8519	20·198	16
17	·7963	17·370	·8148	18·235	·8333	19·123	·8519	20·037	·8704	20·975	17
18	·8148	18·123	·8333	19·000	·8519	19·901	·8704	20·827	·8889	21·778	18
19	·8333	18·901	·8519	19.790	·8704	20.704	·8889	21·642	·9074	22·605	19
20	·8519	19·704	·8704	20·605	·8889	21·531	·9074	22·481	·9259	23·457	20
21	·8704	20·531	·8889	21·444	·9074	22·383	·9259	23·346	·9444	24·333	21
22	·8889	21·383	·9074	22·309	·9259	23·259	·9444	24·235	·9630	25·235	22
23	·9074	22·259	·9259	23·198	·9444	24·160	·9630	25·148	·9815	26·160	23
24	·9259	23·160	·9444	24·111	·9630	25·086	·9815	26·086	1·0000	27·111	24
25	·9444	24·086	·9630	25·049	·9815	26·037	1·0000	27·049	1·0185	28·086	25
26	·9630	25·037	·9815	26·012	1·0000	27·012	1·0185	28·037	1·0370	29·086	26
27	·9815	26·012	1·0000	27·000	1·0185	28·012	1·0370	29·049	1·0556	30·111	27
28	1·0000	27·012	1·0185	28·012	1·0370	29·037	1·0556	30·086	1·0741	31·160	28
29	1·0185	28·037	1·0370	29·049	1·0556	30·086	1·0741	31·148	1·0926	32·235	29
30	1·0370	29·086	1·0556	30·111	1·0741	31·160	1·0926	32·235	1·1111	33·333	30
31	1·0556	30·160	1·0741	31·198	1·0926	32·259	1·1111	33·346	1·1296	34·457	31
32	1·0741	31·259	1·0926	32·309	1·1111	33·383	1·1296	34·481	1·1481	35·605	32
33	1·0926	32·383	1·1111	33·444	1·1296	34·531	1·1481	35·642	1·1667	36·778	33
34	1·1111	33·531	1·1296	34·605	1·1481	35·704	1·1667	36·827	1·1852	37·975	34
35	1·1296	34·704	1·1481	35·790	1·1667	36·901	1·1852	38·037	1·2047	39·198	35
36	1·1481	35·901	1·1667	37·000	1·1852	38·123	1·2047	39·272	1·2222	40·444	36
37	1·1667	37·123	1·1852	38·235	1·2047	39·370	1·2222	40·531	1·2407	41·716	37
38	1·1852	38·370	1·2047	39·494	1·2222	40·642	1·2407	41·815	1·2593	43 012	38
39	1·2047	39·642	1·2222	40·778	1·2047	41·938	1·2593	43·123	1·2778	44·333	39
40	1·2222	40·938	1·2407	42·086	1·2593	43·259	1·2778	44·457	1·2963	45·679	40

TABLE XXXI.—BASE 1.—SLOPES 1 to 1.

Feet.	31		32		33		34		35		Feet.
	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	
0	·5741	11·864	·5926	12·642	·6111	13·444	·6296	14·272	·6481	15·123	0
1	·5926	12·259	·6111	13·049	·6292	13·864	·6481	14·704	·6667	15·568	1
2	·6111	12·679	·6296	13·481	·6481	14·309	·6667	15·160	·6852	16·037	2
3	·6296	13·123	·6481	13·938	·6667	14·778	·6852	15·642	·7037	16·531	3
4	·6481	13·593	·6667	14·420	·6852	15·272	·7037	16·148	·7222	17·049	4
5	·6667	14·086	·6852	14·926	·7037	15·790	·7222	16·679	·7407	17·593	5
6	·6852	14·605	·7037	15·457	·7222	16·333	·7407	17·235	·7593	18·160	6
7	·7037	15·148	·7222	16·012	·7407	16·901	·7593	17·815	·7778	18·753	7
8	·7222	15·716	·7407	16·593	·7593	17·494	·7778	18·420	·7963	19·370	8
9	·7407	16·309	·7593	17·198	·7778	18·111	·7963	19·049	·8148	20·012	9
10	·7593	16·926	·7778	17·827	·7963	18·753	·8148	19·704	·8333	20·679	10
11	·7778	17·568	·7963	18·481	·8148	19·420	·8333	20·383	·8519	21·370	11
12	·7963	18·235	·8148	19·160	·8333	20·111	·8519	21·086	·8704	22·086	12
13	·8148	18·926	·8333	19·864	·8519	20·827	·8704	21·815	·8889	22·827	13
14	·8333	19·642	·8519	20·593	·8704	21·568	·8889	22·568	·9074	23·593	14
15	·8519	20·383	·8704	21·346	·8889	22·333	·9074	23·346	·9259	24·383	15
16	·8704	21·148	·8889	22·123	·9074	23·123	·9259	24·148	·9444	25·198	16
17	·8889	21·938	·9074	22·926	·9259	23·938	·9444	24·975	·9630	26·037	17
18	·9074	22·753	·9259	23·753	·9444	24·778	·9630	25·827	·9815	26·901	18
19	·9259	23·593	·9444	24·605	·9630	25·642	·9815	26·704	1·0000	27·790	19
20	·9444	24·457	·9630	25·481	·9815	26·531	1·0000	27·605	1·0185	28·704	20
21	·9630	25·346	·9815	26·383	1·0000	27·444	1·0185	28·531	1·0370	29·642	21
22	·9815	26·259	1·0000	27·309	1·0185	28·383	1·0370	29·481	1·0556	30·605	22
23	1·0000	27·198	1·0185	28·259	1·0370	29·346	1·0556	30·457	1·0741	31·593	23
24	1·0185	28·160	1·0370	29·235	1·0556	30·333	1·0741	31·457	1·0926	32·605	24
25	1·0370	29·148	1·0556	30·235	1·0741	31·346	1·0926	32·481	1·1111	33·642	25
26	1·0556	30·160	1·0741	31·259	1·0926	32·383	1·1111	33·531	1·1296	34·704	26
27	1·0741	31·198	1·0926	32·309	1·1111	33·444	1·1296	34·605	1·1481	35·790	27
28	1·0926	32·259	1·1111	33·383	1·1296	34·531	1·1481	35·704	1·1667	36·901	28
29	1·1111	33·346	1·1296	34·481	1·1481	35·642	1·1667	36·827	1·1852	38·037	29
30	1·1296	34·457	1·1481	35·605	1·1667	36·778	1·1852	37·975	1·2047	39·198	30
31	1·1481	35·593	1·1667	36·753	1·1852	37·938	1·2047	39·148	1·2222	40·383	31
32	1·1667	36·753	1·1852	37·926	1·2047	39·123	1·2222	40·346	1·2407	41·593	32
33	1·1852	37·938	1·2047	39·123	1·2222	40·333	1·2407	41·568	1·2593	42·827	33
34	1·2047	39·148	1·2222	40·346	1·2407	41·568	1·2593	42·815	1·2778	44·086	34
35	1·2222	40·383	1·2407	41·593	1·2593	42·827	1·2778	44·086	1·2963	45·370	35
36	1·2407	41·642	1·2593	42·864	1·2778	44·111	1·2963	45·383	1·3148	46·679	36
37	1·2593	42·926	1·2778	44·160	1·2963	45·420	1·3148	46·704	1·3333	48·012	37
38	1·2778	44·235	1·2963	45·481	1·3148	46·753	1·3333	48·049	1·3519	49·370	38
39	1·2963	45·568	1·3148	46·827	1·3333	48·111	1·3519	49·420	1·3704	50·753	39
40	1·3148	46·926	1·3333	48·198	1·3519	49·494	1·3704	50·815	1·3889	52·160	40

TABLE XXXII.—BASE 1.—SLOPES 1 to 1,

Feet.	36		37		38		39		40		Feet.
	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	
0	·6667	16·000	·6852	16·901	·7037	17·827	·7222	18·778	·7407	19·753	0
1	·6852	16·457	·7037	17·370	·7222	18·309	·7407	19·272	·7593	20·259	1
2	·7037	16·938	·7222	17·864	·7407	18·815	·7593	19·790	·7778	20·790	2
3	·7222	17·444	·7407	18·383	·7593	19·346	·7778	20·333	·7963	21·346	3
4	·7407	17·975	·7593	18·926	·7778	19·901	·7963	20·901	·8148	21·926	4
5	·7593	18·531	·7778	19·494	·7963	20·481	·8148	21·494	·8333	22·531	5
6	·7778	19·111	·7963	20·086	·8148	21·086	·8333	22·111	·8519	23·160	6
7	·7963	19·716	·8148	20·704	·8333	21·716	·8519	22·753	·8704	23·815	7
8	·8148	20·346	·8333	21·346	·8519	22·370	·8704	23·420	·8889	24·494	8
9	·8333	21·000	·8519	22·012	·8704	23·049	·8889	24·111	·9074	25·198	9
10	·8519	21·679	·8704	22·704	·8889	23·753	·9074	24·847	·9259	25·926	10
11	·8704	22·383	·8889	23·420	·9074	24·481	·9259	25·568	·9444	26·679	11
12	·8889	23·111	·9074	24·160	·9259	25·235	·9444	26·333	·9630	27·457	12
13	·9074	23·864	·9259	24·926	·9444	26·012	·9630	27·123	·9815	28·259	13
14	·9259	24·642	·9444	25·716	·9630	26·815	·9815	27·938	1·0000	29·086	14
15	·9444	25·444	·9630	26·531	·9815	27·642	1·0000	28·778	1·0185	29·938	15
16	·9630	26·272	·9815	27·370	1·0000	28·494	1·0185	29·642	1·0370	30·815	16
17	·9815	27·123	1·0000	28·235	1·0185	29·370	1·0370	30·531	1·0556	31·716	17
18	1·0000	28·000	1·0185	29·123	1·0370	30·272	1·0556	31·444	1·0741	32·642	18
19	1·0185	28·901	1·0370	30·037	1·0556	31·198	1·0741	32·383	1·0926	33·593	19
20	1·0370	29·827	1·0556	30·975	1·0741	32·148	1·0926	33·346	1·1111	34·568	20
21	1·0556	30·778	1·0741	31·938	1·0926	33·123	1·1111	34·333	1·1296	35·568	21
22	1·0741	31·753	1·0926	32·926	1·1111	34·123	1·1296	35·346	1·1481	36·593	22
23	1·0926	32·753	1·1111	33·938	1·1296	35·148	1·1481	36·383	1·1667	37·642	23
24	1·1111	33·778	1·1296	34·975	1·1481	36·198	1·1667	37·444	1·1852	38·716	24
25	1·1296	34·827	1·1481	36·037	1·1667	37·272	1·1852	38·531	1·2047	39·815	25
26	1·1481	35·901	1·1667	37·123	1·1852	38·370	1·2047	39·642	1·2222	40·938	26
27	1·1667	37·000	1·1852	38·235	1·2047	39·494	1·2222	40·778	1·2407	42·086	27
28	1·1852	38·123	1·2047	39·370	1·2222	40·642	1·2407	41·938	1·2593	43·259	28
29	1·2047	39·272	1·2222	40·531	1·2407	41·815	1·2593	43·123	1·2778	44·457	29
30	1·2222	40·444	1·2407	41·716	1·2593	43·012	1·2778	44·333	1·2963	45·679	30
31	1·2407	41·642	1·2593	42·926	1·2778	44·235	1·2963	45·568	1·3148	46·926	31
32	1·2593	42·864	1·2778	44·160	1·2963	45·481	1·3148	46·827	1·3333	48·198	32
33	1·2778	44·111	1·2963	45·420	1·3148	46·753	1·3333	48·111	1·3519	49·494	33
34	1·2963	45·383	1·3148	46·704	1·3333	48·049	1·3519	49·420	1·3704	50·815	34
35	1·3148	46·679	1·3333	48·012	1·3519	49·370	1·3704	50·753	1·3889	52·160	35
36	1·3333	48·000	1·3519	49·346	1·3704	50·716	1·3889	52·111	1·4074	53·531	36
37	1·3519	49·346	1·3704	50·704	1·3889	52·086	1·4074	53·494	1·4259	54·926	37
38	1·3704	50·716	1·3889	52·086	1·4074	53·481	1·4259	54·901	1·4444	56·346	38
39	1·3889	52·111	1·4074	53·494	1·4259	54·901	1·4444	56·333	1·4630	57·790	39
40	1·4074	53·531	1·4259	54·926	1·4444	56·346	1·4630	57·790	1·4815	59·259	40

TABLE XXXIII.—BASE 1.—SLOPES 1½ to 1.

Feet.	1		2		3		4		5		Feet.
	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	
0	·0185	·019	·0370	·074	·0556	·167	·0741	·296	·0926	·463	0
1	·0370	·056	·0556	·130	·0741	·241	·0926	·389	·1111	·574	1
2	·0556	·130	·0741	·222	·0926	·352	·1111	·519	·1296	·722	2
3	·0741	·241	·0926	·352	·1111	·500	·1296	·685	·1481	·907	3
4	·0926	·389	·1111	·519	·1296	·685	·1481	·889	·1667	1·130	4
5	·1111	·574	·1296	·722	·1481	·907	·1667	1·130	·1852	1·389	5
6	·1296	·796	·1481	·963	·1667	1·167	·1852	1·407	·2037	1·685	6
7	·1481	1·056	·1667	1·241	·1852	1·463	·2037	1·722	·2222	2·019	7
8	·1667	1·352	·1852	1·556	·2037	1·796	·2222	2·074	·2407	2·389	8
9	·1852	1·685	·2037	1·907	·2222	2·167	·2407	2·463	·2593	2·796	9
10	·2037	2·056	·2222	2·296	·2407	2·574	·2593	2·889	·2778	3·241	10
11	·2222	2·463	·2407	2·722	·2593	3·019	·2778	3·352	·2963	3·722	11
12	·2407	2·907	·2593	3·185	·2778	3·500	·2963	3·852	·3148	4·241	12
13	·2593	3·389	·2778	3·685	·2963	4·019	·3148	4·389	·3333	4·796	13
14	·2778	3·907	·2963	4·222	·3148	4·574	·3333	4·963	·3519	5·389	14
15	·2963	4·463	·3148	4·796	·3333	5·167	·3519	5·574	·3704	6·019	15
16	·3148	5·056	·3333	5·407	·3519	5·796	·3704	6·222	·3889	6·685	16
17	·3333	5·685	·3519	6·056	·3704	6·463	·3889	6·907	·4074	7·389	17
18	·3519	6·352	·3704	6·741	·3889	7·167	·4074	7·630	·4259	8·130	18
19	·3704	7·056	·3889	7·463	·4074	7·907	·4259	8·389	·4444	8·907	19
20	·3889	7·796	·4074	8·222	·4259	8·685	·4444	9·185	·4630	9·722	20
21	·4074	8·574	·4259	9·019	·4444	9·500	·4630	10·019	·4815	10·574	21
22	·4259	9·389	·4444	9·852	·4630	10·352	·4815	10·889	·5000	11·463	22
23	·4444	10·241	·4630	10·722	·4815	11·241	·5000	11·796	·5185	12·389	23
24	·4630	11·130	·4815	11·630	·5000	12·167	·5185	12·741	·5370	13·352	24
25	·4815	12·056	·5000	12·574	·5185	13·130	·5370	13·722	·5556	14·352	25
26	·5000	13·019	·5185	13·556	·5370	14·130	·5556	14·741	·5741	15·389	26
27	·5185	14·019	·5370	14·574	·5556	15·167	·5741	15·796	·5926	16·463	27
28	·5370	15·056	·5556	15·630	·5741	16·241	·5926	16·889	·6111	17·574	28
29	·5556	16·130	·5741	16·722	·5926	17·352	·6111	18·019	·6296	18·722	29
30	·5741	17·241	·5926	17·852	·6111	18·500	·6296	19·185	·6481	19·907	30
31	·5926	18·389	·6111	19·019	·6296	19·685	·6481	20·389	·6667	21·130	31
32	·6111	19·574	·6296	20·222	·6481	20·907	·6667	21·630	·6852	22·389	32
33	·6296	20·796	·6481	21·463	·6667	22·167	·6852	22·907	·7037	23·685	33
34	·6481	22·056	·6667	22·741	·6852	23·463	·7037	24·222	·722	25·019	34
35	·6667	23·352	·6852	24·056	·7037	24·796	·7222	25·574	·740	26·389	35
36	·6852	24·685	·7037	25·407	·7222	26·167	·7407	26·963	·759	27·796	36
37	·7037	26·056	·7222	26·796	·7407	27·574	·7593	28·389	·777	29·241	37
38	·7222	27·463	·7407	28·222	·7593	29·019	·7778	29·852	·7963	30·722	38
39	·7407	28·907	·7593	29·685	·7778	30·500	·7963	31·352	·8148	32·241	39
40	·7593	30·389	·7778	31·185	·7963	32·019	·8148	32·889	·8333	33·796	40

TABLE XXXIV.—BASE 1.—SLOPES $1\frac{1}{2}$ to 1.

Feet.	6		7		8		9		10		Feet.
	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	
0	·1111	·667	·1296	·907	·1481	1·185	·1667	1·500	·1852	1·852	0
1	·1296	·796	·1481	1·056	·1667	1·352	·1852	1·685	·2037	2·056	1
2	·1481	·963	·1667	1·241	·1852	1·556	·2037	1·907	·2222	2·296	2
3	·1667	1·167	·1852	1·463	·2037	1·796	·2222	2·167	·2407	2·574	3
4	·1852	1·407	·2037	1·722	·2222	2·074	·2407	2·463	·2593	2·889	4
5	·2037	1·685	·2222	2·019	·2407	2·389	·2593	2·796	·2778	3·241	5
6	·2222	2·000	·2407	2·352	·2593	2·741	·2778	3·167	·2963	3·630	6
7	·2407	2·352	·2593	2·722	·2778	3·130	·2963	3·574	·3148	4·056	7
8	·2593	2·741	·2778	3·130	·2963	3·556	·3148	4·019	·3333	4·519	8
9	·2778	3·167	·2963	3·574	·3148	4·019	·3333	4·500	·3519	5·019	9
10	·2963	3·630	·3148	4·056	·3333	4·519	·3519	5·019	·3704	5·556	10
11	·3148	4·130	·3333	4·574	·3519	5·056	·3704	5·574	·3889	6·130	11
12	·3333	4·667	·3519	5·130	·3704	5·630	·3889	6·167	·4074	6·741	12
13	·3519	5·241	·3704	5·722	·3889	6·241	·4074	6·796	·4259	7·389	13
14	·3704	5·852	·3889	6·352	·4074	6·889	·4259	7·463	·4444	8·074	14
15	·3889	6·500	·4074	7·019	·4259	7·574	·4444	8·167	·4630	8·796	15
16	·4074	7·185	·4259	7·722	·4444	8·296	·4630	8·907	·4815	9·556	16
17	·4259	7·907	·4444	8·463	·4630	9·056	·4815	9·685	·5000	10·352	17
18	·4444	8·667	·4630	9·241	·4815	9·852	·5000	10·500	·5185	11·185	18
19	·4630	9·463	·4815	10·056	·5000	10·685	·5185	11·352	·5370	12·056	19
20	·4815	10·296	·5000	10·907	·5185	11·556	·5370	12·241	·5556	12·963	20
21	·5000	11·167	·5185	11·796	·5370	12·463	·5556	13·167	·5741	13·907	21
22	·5185	12·074	·5370	12·722	·5556	13·407	·5741	14·130	·5926	14·889	22
23	·5370	13·019	·5556	13·685	·5741	14·389	·5926	15·130	·6111	15·907	23
24	·5556	14·000	·5741	14·685	·5926	15·407	·6111	16·167	·6296	16·963	24
25	·5741	15·019	·5926	15·722	·6111	16·463	·6296	17·241	·6481	18·056	25
26	·5926	16·074	·6111	16·796	·6296	17·556	·6481	18·352	·6667	19·185	26
27	·6111	17·167	·6296	17·907	·6481	18·685	·6667	19·500	·6852	20·352	27
28	·6296	18·296	·6481	19·056	·6667	19·852	·6852	20·685	·7037	21·556	28
29	·6481	19·463	·6667	20·241	·6852	21·056	·7037	21·907	·7222	22·796	29
30	·6667	20·667	·6852	21·463	·7037	22·296	·7222	23·167	·7407	24·074	30
31	·6852	21·907	·7037	22·722	·7222	23·574	·7407	24·463	·7593	25·389	31
32	·7037	23·185	·7222	24·019	·7407	24·889	·7593	25·796	·7778	26·741	32
33	·7222	24·500	·7407	25·352	·7593	26·241	·7778	27·167	·7963	28·130	33
34	·7407	25·852	·7593	26·722	·7778	27·630	·7963	28·574	·8148	29·556	34
35	·7593	27·241	·7778	28·130	·7963	29·056	·8148	30·019	·8333	31·019	35
36	·7778	28·667	·7963	29·574	·8148	30·519	·8333	31·500	·8519	32·519	36
37	·7963	30·130	·8148	31·056	·8333	32·019	·8519	33·019	·8704	34·056	37
38	·8148	31·630	·8333	32·574	·8519	33·556	·8704	34·574	·8889	35·630	38
39	·8333	33·167	·8519	34·130	·8704	35·130	·8889	36·167	·9074	37·241	39
40	·8519	34·741	·8704	35·722	·8889	36·741	·9074	37·796	·9259	38·889	40

TABLE XXXV.—BASE 1.—SLOPES $1\frac{1}{2}$ to 1.

Feet.	11		12		13		14		15		Feet.
	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	
0	·2037	2·241	·2222	2·667	·2407	3·130	·2593	3·630	·2778	4·167	0
1	·2222	2·463	·2407	2·907	·2593	3·389	·2778	3·907	·2963	4·463	1
2	·2407	2·722	·2593	3·185	·2778	3·685	·2963	4·222	·3148	4·796	2
3	·2593	3·019	·2778	3·500	·2963	4·019	·3148	4·574	·3333	5·167	3
4	·2778	3·352	·2963	3·852	·3148	4·389	·3333	4·963	·3519	5·574	4
5	·2963	3·722	·3148	4·241	·3333	4·796	·3519	5·389	·3704	6·019	5
6	·3148	4·130	·3333	4·667	·3519	5·241	·3704	5·852	·3889	6·500	6
7	·3333	4·574	·3519	5·130	·3704	5·722	·3889	6·352	·4074	7·019	7
8	·3519	5·056	·3704	5·630	·3889	6·241	·4074	6·889	·4259	7·574	8
9	·3704	5·574	·3889	6·167	·4074	6·796	·4259	7·463	·4444	8·167	9
10	·3889	6·130	·4074	6·741	·4259	7·389	·4444	8·074	·4630	8·796	10
11	·4074	6·722	·4259	7·352	·4444	8·019	·4630	8·722	·4815	9·463	11
12	·4259	7·352	·4444	8·000	·4630	8·685	·4815	9·407	·5000	10·167	12
13	·4444	8·019	·4630	8·685	·4815	9·389	·5000	10·130	·5185	10·907	13
14	·4630	8·722	·4815	9·407	·5000	10·130	·5185	10·889	·5370	11·685	14
15	·4815	9·463	·5000	10·167	·5185	10·907	·5370	11·685	·5556	12·500	15
16	·5000	10·241	·5185	10·963	·5370	11·722	·5556	12·519	·5741	13·352	16
17	·5185	11·056	·5370	11·796	·5556	12·574	·5741	13·389	·5926	14·241	17
18	·5370	11·907	·5556	12·667	·5741	13·463	·5926	14·296	·6111	15·167	18
19	·5556	12·796	·5741	13·574	·5926	14·389	·6111	15·241	·6296	16·130	19
20	·5741	13·722	·5926	14·519	·6111	15·352	·6296	16·222	·6481	17·130	20
21	·5926	14·685	·6111	15·500	·6296	16·352	·6481	17·241	·6667	18·167	21
22	·6111	15·685	·6296	16·519	·6481	17·389	·6667	18·296	·6852	19·241	22
23	·6296	16·722	·6481	17·574	·6667	18·463	·6852	19·389	·7037	20·352	23
24	·6481	17·796	·6667	18·667	·6852	19·574	·7037	20·519	·7222	21·500	24
25	·6667	18·907	·6852	19·796	·7037	20·722	·7222	21·685	·7407	22·685	25
26	·6852	20·056	·7037	20·963	·7222	21·907	·7407	22·889	·7593	23·907	26
27	·7037	21·241	·7222	22·167	·7407	23·130	·7593	24·130	·7778	25·167	27
28	·7222	22·463	·7407	23·407	·7593	24·389	·7778	25·407	·7963	26·463	28
29	·7407	23·722	·7593	24·685	·7778	25·685	·7963	26·722	·8148	27·796	29
30	·7593	25·019	·7778	26·000	·7963	27·019	·8148	28·074	·8333	29·167	30
31	·7778	26·352	·7963	27·352	·8148	28·389	·8333	29·463	·8519	30·574	31
32	·7963	27·722	·8148	28·741	·8333	29·796	·8519	30·889	·8704	32·019	32
33	·8148	29·130	·8333	30·167	·8519	31·241	·8704	32·352	·8889	33·500	33
34	·8333	30·574	·8519	31·630	·8704	32·722	·8889	33·852	·9074	35·019	34
35	·8519	32·056	·8704	33·130	·8889	34·241	·9074	35·389	·9259	36·574	35
36	·8704	33·574	·8889	34·667	·9074	35·796	·9259	36·963	·9444	38·167	36
37	·8889	35·130	·9074	36·241	·9259	37·389	·9444	38·574	·9630	39·796	37
38	·9074	36·722	·9259	37·852	·9444	39·019	·9630	40·222	·9815	41·463	38
39	·9259	38·352	·9444	39·500	·9630	40·685	·9815	41·907	1·0000	43·167	39
40	·9444	40·019	·9630	41·185	·9815	42·389	1·0000	43·630	1·0185	44·907	40

TABLE XXXVI.– BASE 1.—SLOPES 1½ to 1.

Feet.	16		17		18		19		20		Feet.
	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	
0	·2963	4·741	·3148	5·352	·3333	6·000	·3519	6·685	·3704	7·407	0
1	·3148	5·056	·3333	5·685	·3519	6·352	·3704	7·056	·3889	7·796	1
2	·3333	5·407	·3519	6·056	·3704	6·741	·3889	7·463	·4074	8·222	2
3	·3519	5·796	·3704	6·463	·3889	7·167	·4074	7·907	·4259	8·685	3
4	·3704	6·222	·3889	6·907	·4074	7·630	·4259	8·389	·4444	9·185	4
5	·3889	6·685	·4074	7·389	·4259	8·130	·4444	8·907	·4630	9·722	5
6	·4074	7·185	·4259	7·907	·4444	8·667	·4630	9·463	·4815	10·296	6
7	·4259	7·722	·4444	8·463	·4630	9·241	·4815	10·056	·5000	10·907	7
8	·4444	8·296	·4630	9·056	·4815	9·852	·5000	10·685	·5185	11·556	8
9	·4630	8·907	·4815	9·685	·5000	10·500	·5185	11·352	·5370	12·241	9
10	·4815	9·556	·5000	10·352	·5185	11·185	·5370	12·056	·5556	12·963	10
11	·5000	10·241	·5185	11·056	·5370	11·907	·5556	12·796	·5741	13·722	11
12	·5185	10·963	·5370	11·796	·5556	12·667	·5741	13·574	·5926	14·519	12
13	·5370	11·722	·5556	12·574	·5741	13·463	·5926	14·389	·6111	15·352	13
14	·5556	12·519	·5741	13·389	·5926	14·296	·6111	15·241	·6296	16·222	14
15	·5741	13·352	·5926	14·241	·6111	15·167	·6296	16·130	·6481	17·130	15
16	·5926	14·222	·6111	15·130	·6296	16·074	·6481	17·056	·6667	18·074	16
17	·6111	15·130	·6296	16·056	·6481	17·019	·6667	18·019	·6852	19·056	17
18	·6296	16·074	·6481	17·019	·6667	18·000	·6852	19·019	·7037	20·074	18
19	·6481	17·056	·6667	18·019	·6852	19·019	·7037	20·056	·7222	21·130	19
20	·6667	18·074	·6852	19·056	·7037	20·074	·7222	21·130	·7407	22·222	20
21	·6852	19·130	·7037	20·130	·7222	21·167	·7407	22·241	·7593	23·352	21
22	·7037	20·222	·7222	21·241	·7407	22·296	·7593	23·389	·7778	24·519	22
23	·7222	21·352	·7407	22·389	·7593	23·463	·7778	24·574	·7963	25·722	23
24	·7407	22·519	·7593	23·574	·7778	24·667	·7963	25·796	·8148	26·963	24
25	·7593	23·722	·7778	24·796	·7963	25·907	·8148	27·056	·8333	28·241	25
26	·7778	24·963	·7963	26·056	·8148	27·185	·8333	28·352	·8519	29·556	26
27	·7963	26·241	·8148	27·352	·8333	28·500	·8519	29·685	·8704	30·907	27
28	·8148	27·556	·8333	28·685	·8519	29·852	·8704	31·056	·8889	32·296	28
29	·8333	28·907	·8519	30·056	·8704	31·241	·8889	32·463	·9074	33·722	29
30	·8519	30·296	·8704	31·463	·8889	32·667	·9074	33·907	·9259	35·185	30
31	·8704	31·722	·8889	32·907	·9074	34·130	·9259	35·389	·9444	36·685	31
32	·8889	33·185	·9074	34·389	·9259	35·630	·9444	36·907	·9630	38·222	32
33	·9074	34·685	·9259	35·907	·9444	37·167	·9630	38·463	·9815	39·796	33
34	·9259	36·222	·9444	37·463	·9630	38·741	·9815	40·056	1·0000	41·407	34
35	·9444	37·796	·9630	39·056	·9815	40·352	1·0000	41·685	1·0185	43·056	35
36	·9630	39·407	·9815	40·685	1·0000	42·000	1·0185	43·352	1·0370	44·741	36
37	·9815	41·056	1·0000	42·352	1·0185	43·685	1·0370	45·056	1·0556	46·463	37
38	1·0000	42·741	1·0185	44·056	1·0370	45·407	1·0556	46·796	1·0741	48·222	38
39	1·0185	44·463	1·0370	45·796	1·0556	47·167	1·0741	48·574	1·0926	50·019	39
40	1·0370	46·222	1·0556	47·574	1·0741	48·963	1·0926	50·389	1·1111	51·852	40

TABLE XXXVII.—BASE 1.—SLOPES 1½ to 1.

Feet.	21		22		23		24		25		Feet.
	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	
0	·3889	8·167	·4074	8·963	·4259	9·796	·4444	10·667	·4630	11·574	0
1	·4074	8·574	·4259	9·389	·4444	10·241	·4630	11·130	·4815	12·056	1
2	·4259	9·019	·4444	9·852	·4630	10·722	·4815	11·630	·5000	12·574	2
3	·4444	9·500	·4630	10·352	·4815	11·241	·5000	12·167	·5185	13·130	3
4	·4630	10·019	·4815	10·889	·5000	11·796	·5185	12·741	·5370	13·722	4
5	·4815	10·574	·5000	11·463	·5185	12·389	·5370	13·352	·5556	14·352	5
6	·5000	11·167	·5185	12·074	·5370	13·019	·5556	14·000	·5741	15·019	6
7	·5185	11·796	·5370	12·722	·5556	13·685	·5741	14·685	·5926	15·722	7
8	·5370	12·463	·5556	13·407	·5741	14·389	·5926	15·407	·6111	16·463	8
9	·5556	13·167	·5741	14·130	·5926	15·130	·6111	16·167	·6296	17·241	9
10	·5741	13·907	·5926	14·889	·6111	15·907	·6296	16·963	·6481	18·056	10
11	·5926	14·685	·6111	15·685	·6296	16·722	·6481	17·796	·6667	18·907	11
12	·6111	15·500	·6296	16·519	·6481	17·574	·6667	18·667	·6852	19·796	12
13	·6296	16·352	·6481	17·389	·6667	18·463	·6852	19·574	·7037	20·722	13
14	·6481	17·241	·6667	18·296	·6852	19·389	·7037	20·519	·7222	21·685	14
15	·6667	18·167	·6852	19·241	·7037	20·352	·7222	21·500	·7407	22·685	15
16	·6852	19·130	·7037	20·222	·7222	21·352	·7407	22·519	·7593	23·722	16
17	·7037	20·130	·7222	21·241	·7407	22·389	·7593	23·574	·7778	24·796	17
18	·7222	21·167	·7407	22·296	·7593	23·463	·7778	24·667	·7963	25·907	18
19	·7407	22·241	·7593	23·389	·7778	24·574	·7963	25·796	·8148	27·056	19
20	·7593	23·352	·7778	24·519	·7963	25·722	·8148	26·963	·8333	28·241	20
21	·7778	24·500	·7963	25·685	·8148	26·907	·8333	28·167	·8519	29·463	21
22	·7963	25·685	·8148	26·889	·8333	28·130	·8519	29·407	·8704	30·722	22
23	·8148	26·907	·8333	28·130	·8519	29·389	·8704	30·685	·8889	32·019	23
24	·8333	28·167	·8519	29·407	·8704	30·685	·8889	32·000	·9074	33·352	24
25	·8519	29·463	·8704	30·722	·8889	32·019	·9074	33·352	·9259	34·722	25
26	·8704	30·796	·8889	32·074	·9074	33·389	·9259	34·741	·9444	36·130	26
27	·8889	32·167	·9074	33·463	·9259	34·796	·9444	36·167	·9630	37·574	27
28	·9074	33·574	·9259	34·889	·9444	36·241	·9630	37·630	·9815	39·056	28
29	·9259	35·019	·9444	36·352	·9630	37·722	·9815	39·130	1·0000	40·574	29
30	·9444	36·500	·9630	37·852	·9815	39·241	1·0000	40·667	1·0185	42·130	30
31	·9630	38·019	·9815	39·389	1·0000	40·796	1·0185	42·241	1·0370	43·722	31
32	·9815	39·574	1·0000	40·963	1·0185	42·389	1·0370	43·852	1·0556	45·352	32
33	1·0000	41·167	1·0185	42·574	1·0370	44·019	1·0556	45·500	1·0741	47·019	33
34	1·0185	42·796	1·0370	44·222	1·0556	45·685	1·0741	47·185	1·0926	48·722	34
35	1·0370	44·463	1·0556	45·907	1·0741	47·389	1·0926	48·907	1·1111	50·463	35
36	1·0556	46·167	1·0741	47·630	1·0926	49·130	1·1111	50·667	1·1296	52·241	36
37	1·0741	47·907	1·0926	49·389	1·1111	50·907	1·1296	52·463	1·1481	54·056	37
38	1·0926	49·685	1·1111	51·185	1·1296	52·722	1·1481	54·296	1·1667	55·907	38
39	1·1111	51·500	1·1296	53·019	1·1481	54·574	1·1667	56·167	1·1852	57·796	39
40	1·1296	53·352	1·1481	54·889	1·1667	56·463	1·1852	58·074	1·2047	59·722	40

TABLE XXXVIII.—BASE 1.—SLOPES 1½ to 1.

Feet.	26		27		28		29		30		Feet.
	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	
0	·4815	12·519	·5000	13·500	·5185	14·519	·5370	15·574	·5556	16·667	0
1	·5000	13·019	·5185	14·019	·5370	15·056	·5556	16·130	·5741	17·241	1
2	·5185	13·556	·5370	14·574	·5556	15·630	·5741	16·722	·5926	17·852	2
3	·5370	14·130	·5556	15·167	·5741	16·241	·5926	17·352	·6111	18·500	3
4	·5556	14·741	·5741	15·796	·5926	16·889	·6111	18·019	·6296	19·185	4
5	·5741	15·389	·5926	16·463	·6111	17·574	·6296	18·722	·6481	19·907	5
6	·5926	16·074	·6111	17·167	·6296	18·296	·6481	19·463	·6667	20·667	6
7	·6111	16·796	·6296	17·907	·6481	19·056	·6667	20·241	·6852	21·463	7
8	·6296	17·556	·6481	18·685	·6667	19·852	·6852	21·056	·7037	22·296	8
9	·6481	18·352	·6667	19·500	·6852	20·685	·7037	21·907	·7222	23·167	9
10	·6667	19·185	·6852	20·352	·7037	21·556	·7222	22·796	·7407	24·074	10
11	·6852	20·056	·7037	21·241	·7222	22·463	·7407	23·722	·7593	25·019	11
12	·7037	20·963	·7222	22·167	·7407	23·407	·7593	24·685	·7778	26·000	12
13	·7222	21·907	·7407	23·130	·7593	24·389	·7778	25·685	·7963	27·019	13
14	·7407	22·889	·7593	24·130	·7778	25·407	·7963	26·722	·8148	28·074	14
15	·7593	23·907	·7778	25·167	·7963	26·463	·8148	27·796	·8333	29·167	15
16	·7778	24·963	·7963	26·241	·8148	27·556	·8333	28·907	·8519	30·296	16
17	·7963	26·056	·8148	27·352	·8333	28·685	·8519	30·056	·8704	31·463	17
18	·8148	27·185	·8333	28·500	·8519	29·852	·8704	31·241	·8889	32·667	18
19	·8333	28·352	·8519	29·685	·8704	31·056	·8889	32·463	·9074	33·907	19
20	·8519	29·556	·8704	30·907	·8889	32·296	·9074	33·722	·9259	35·185	20
21	·8704	30·796	·8889	32·167	·9074	33·574	·9259	35·019	·9444	36·500	21
22	·8889	32·074	·9074	33·463	·9259	34·889	·9444	36·352	·9630	37·852	22
23	·9074	33·389	·9259	34·796	·9444	36·241	·9630	37·722	·9815	39·241	23
24	·9259	34·741	·9444	36·167	·9630	37·630	·9815	39·130	1·0000	40·667	24
25	·9444	36·130	·9630	37·574	·9815	39·056	1·0000	40·574	1·0185	42·130	25
26	·9630	37·556	·9815	39·019	1·0000	40·519	1·0185	42·056	1·0370	43·630	26
27	·9815	39·019	1·0000	40·500	1·0185	42·019	1·0370	43·574	1·0556	45·167	27
28	1·0000	40·519	1·0185	42·019	1·0370	43·556	1·0556	45·130	1·0741	46·741	28
29	1·0185	42·056	1·0370	43·574	1·0556	45·130	1·0741	46·722	1·0926	48·352	29
30	1·0370	43·630	1·0556	45·167	1·0741	46·741	1·0926	48·352	1·1111	50·000	30
31	1·0556	45·241	1·0741	46·796	1·0926	48·389	1·1111	50·019	1·1296	51·685	31
32	1·0741	46·889	1·0926	48·463	1·1111	50·074	1·1296	51·722	1·1481	53·407	32
33	1·0926	48·574	1·1111	50·167	1·1296	51·796	1·1481	53·463	1·1667	55·167	33
34	1·1111	50·296	1·1296	51·907	1·1481	53·556	1·1667	55·241	1·1852	56·963	34
35	1·1296	52·056	1·1481	53·685	1·1667	55·352	1·1852	57·056	1·2047	58·796	35
36	1·1481	53·852	1·1667	55·500	1·1852	57·185	1·2047	58·907	1·2222	60·667	36
37	1·1667	55·685	1·1852	57·352	1·2047	59·056	1·2222	60·796	1·2407	62·574	37
38	1·1852	57·556	1·2047	59·241	1·2222	60·963	1·2407	62·722	1·2593	64·519	38
39	1·2047	59·463	1·2222	61·167	1·2407	62·907	1·2593	64·685	1·2778	66·500	39
40	1·2222	61·407	1·2407	63·130	1·2593	64·889	1·2778	66·685	1·2963	68·519	40

TABLE XXXIX.—BASE 1.—SLOPES 1½ to 1.

Feet.	31		32		33		34		35		Feet.
	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	
0	·5741	17·796	·5926	18·963	·6111	20·167	·6296	21·407	·6481	22·685	0
1	·5926	18·389	·6111	19·574	·6296	20·796	·6481	22·056	·6667	23·352	1
2	·6111	19·019	·6296	20·222	·6481	21·463	·6667	22·741	·6852	24·056	2
3	·6296	19·685	·6481	20·907	·6667	22·167	·6852	23·463	·7037	24·796	3
4	·6481	20·389	·6667	21·630	·6852	22·907	·7037	24·222	·7222	25·574	4
5	·6667	21·130	·6852	22·389	·7037	23·685	·7222	25·019	·7407	26·389	5
6	·6852	21·907	·7037	23·185	·7222	24·500	·7407	25·852	·7593	27·241	6
7	·7037	22·722	·7222	24·019	·7407	25·352	·7593	26·722	·7778	28·130	7
8	·7222	23·574	·7407	24·889	·7593	26·241	·7778	27·630	·7963	29·056	8
9	·7407	24·463	·7593	25·796	·7778	27·167	·7963	28·574	·8148	30·019	9
10	·7593	25·389	·7778	26·741	·7963	28·130	·8148	29·556	·8333	31·019	10
11	·7778	26·352	·7963	27·722	·8148	29·130	·8333	30·574	·8519	32·056	11
12	·7963	27·352	·8148	28·741	·8333	30·167	·8519	31·630	·8704	33·130	12
13	·8148	28·389	·8333	29·796	·8519	31·241	·8704	32·722	·8889	34·241	13
14	·8333	29·463	·8519	30·889	·8704	32·352	·8889	33·852	·9074	35·389	14
15	·8519	30·574	·8704	32·019	·8889	33·500	·9074	35·019	·9259	36·574	15
16	·8704	31·722	·8889	33·185	·9074	34·685	·9259	36·222	·9444	37·796	16
17	·8889	32·907	·9074	34·389	·9259	35·907	·9444	37·463	·9630	39·056	17
18	·9074	34·130	·9254	35·630	·9444	37·167	·9630	38·741	·9815	40·352	18
19	·9259	35·389	·9444	36·907	·9630	38·463	·9815	40·056	1·0000	41·685	19
20	·9444	36·685	·9630	38·222	·9815	39·796	1·0000	41·407	1·0185	43·056	20
21	·9630	38·019	·9815	39·574	1·0000	41·167	1·0185	42·796	1·0370	44·463	21
22	·9815	39·389	1·0000	40·963	1·0185	42·574	1·0370	44·222	1·0556	45·907	22
23	1·0000	40·796	1·0185	42·389	1·0370	44·019	1·0556	45·685	1·0741	47·389	23
24	1·0185	42·241	1·0370	43·852	1·0556	45·500	1·0741	47·185	1·0926	48·907	24
25	1·0370	43·722	1·0556	45·352	1·0741	47·019	1·0926	48·722	1·1111	50·463	25
26	1·0556	45·241	1·0741	46·889	1·0926	48·574	1·1111	50·296	1·1296	52·056	26
27	1·0741	46·796	1·0926	48·463	1·1111	50·167	1·1296	51·907	1·1481	53·685	27
28	1·0926	48·389	1·1111	50·074	1·1296	51·796	1·1481	53·556	1·1667	55·352	28
29	1·1111	50·019	1·1296	51·722	1·1481	53·463	1·1667	55·241	1·1852	57·056	29
30	1·1296	51·685	1·1481	53·407	1·1667	55·167	1·1852	56·963	1·2047	58·796	30
31	1·1481	53·389	1·1667	55·130	1·1852	56·907	1·2047	58·722	1·2222	60·574	31
32	1·1667	55·130	1·1852	56·889	1·2047	58·685	1·2222	60·519	1·2407	62·389	32
33	1·1852	56·907	1·2047	58·685	1·2222	60·500	1·2407	62·352	1·2593	64·241	33
34	1·2047	58·722	1·2222	60·519	1·2407	62·352	1·2593	64·222	1·2778	66·130	34
35	1·2222	60·574	1·2407	62·389	1·2593	64·241	1·2778	66·130	1·2963	68·056	35
36	1·2407	62·463	1·2593	64·296	1·2778	66·167	1·2963	68·074	1·3148	70·019	36
37	1·2593	64·389	1·2778	66·241	1·2963	68·130	1·3148	70·056	1·3333	72·019	37
38	1·2778	66·352	1·2963	68·222	1·3148	70·130	1·3333	72·074	1·3519	74·056	38
39	1·2963	68·352	1·3148	70·241	1·3333	72·167	1·3519	74·130	1·3704	76·130	39
40	1·3148	70·389	1·3333	72·296	1·3519	74·241	1·3704	76·222	1·3889	78·241	40

TABLE XL.—BASE 1.—SLOPES 1½ to 1.

Feet.	36		37		38		39		40		Feet.
	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	
0	·6667	24·000	·6852	25·352	·7037	26·741	·7222	28·167	·7407	29·630	0
1	·6852	24·685	·7037	26·056	·7222	27·463	·7407	28·907	·7593	30·389	1
2	·7037	25·407	·7222	26·796	·7407	28·222	·7593	29·685	·7778	31·185	2
3	·7222	26·167	·7407	27·574	·7593	29·019	·7778	30·500	·7963	32·019	3
4	·7407	26·963	·7593	28·389	·7778	29·852	·7963	31·352	·8148	32·889	4
5	·7593	27·796	·7778	29·241	·7963	30·722	·8148	32·241	·8333	33·796	5
6	·7778	28·667	·7963	30·130	·8148	31·630	·8333	33·167	·8519	34·741	6
7	·7963	29·574	·8148	31·056	·8333	32·574	·8519	34·130	·8704	35·722	7
8	·8148	30·519	·8333	32·019	·8519	33·556	·8704	35·130	·8889	36·741	8
9	·8333	31·500	·8519	33·019	·8704	34·574	·8889	36·167	·9074	37·796	9
10	·8519	32·529	·8704	34·056	·8889	35·630	·9074	37·241	·9259	38·889	10
11	·8704	33·574	·8889	35·130	·9074	36·722	·9259	38·352	·9444	40·019	11
12	·8889	34·667	·9074	36·241	·9259	37·852	·9444	39·500	·9630	41·185	12
13	·9074	35·796	·9259	37·389	·9444	39·019	·9630	40·685	·9815	42·389	13
14	·9259	36·963	·9444	38·574	·9630	40·222	·9815	41·907	1·0000	43·630	14
15	·9444	38·167	·9630	39·796	·9815	41·463	1·0000	43·167	1·0185	44·907	15
16	·9630	39·407	·9815	41·056	1·0000	42·741	1·0185	44·463	1·0370	46·222	16
17	·9815	40·685	1·0000	42·352	1·0185	44·056	1·0370	45·796	1·0556	47·574	17
18	1·0000	42·000	1·0185	43·685	1·0370	45·407	1·0556	47·167	1·0741	48·963	18
19	1·0185	43·352	1·0370	45·056	1·0556	46·796	1·0741	48·574	1·0926	50·389	19
20	1·0370	44·741	1·0556	46·463	1·0741	48·222	1·0926	50·019	1·1111	51·852	20
21	1·0556	46·167	1·0741	47·907	1·0926	49·685	1·1111	51·500	1·1296	53·352	21
22	1·0741	47·630	1·0926	49·389	1·1111	51·185	1·1296	53·019	1·1481	54·889	22
23	1·0926	49·130	1·1111	50·907	1·1296	52·722	1·1481	54·574	1·1667	56·463	23
24	1·1111	50·667	1·1296	52·463	1·1481	54·296	1·1667	56·167	1·1852	58·074	24
25	1·1296	52·241	1·1481	54·056	1·1667	55·907	1·1852	57·796	1·2047	59·722	25
26	1·1481	53·852	1·1667	55·685	1·1852	57·556	1·2047	59·463	1·2222	61·407	26
27	1·1667	55·500	1·1852	57·352	1·2047	59·241	1·2222	61·167	1·2407	63·130	27
28	1·1852	57·185	1·2047	59·056	1·2222	60·963	1·2407	62·907	1·2593	64·889	28
29	1·2047	58·907	1·2222	60·796	1·2407	62·722	1·2593	64·685	1·2778	66·685	29
30	1·2222	60·667	1·2407	62·574	1·2593	64·519	1·2778	66·500	1·2963	68·519	30
31	1·2407	62·463	1·2593	64·389	1·2778	66·352	1·2963	68·352	1·3148	70·389	31
32	1·2593	64·296	1·2778	66·241	1·2963	68·222	1·3148	70·241	1·3333	72·296	32
33	1·2778	66·167	1·2963	68·130	1·3148	70·130	1·3333	72·167	1·3519	74·241	33
34	1·2963	68·074	1·3148	70·056	1·3333	72·074	1·3519	74·130	1·3704	76·222	34
35	1·3148	70·019	1·3333	72·019	1·3519	74·056	1·3704	76·130	1·3889	78·241	35
36	1·3333	72·000	1·3519	74·019	1·3704	76·074	1·3889	78·167	1·4074	80·296	36
37	1·3519	74·019	1·3704	76·056	1·3889	78·130	1·4074	80·241	1·4259	82·389	37
38	1·3704	76·074	1·3889	78·130	1·4074	80·222	1·4259	82·352	1·4444	84·519	38
39	1·3889	78·167	1·4074	80·241	1·4259	82·352	1·4444	84·500	1·4630	86·685	39
40	1·4074	80·296	1·4259	82·389	1·4444	84·519	1·4630	86·685	1·4815	88·889	40

TABLE XLI.—BASE 1.—SLOPES 2 to 1.

Feet.	1		2		3		4		5		Feet.
	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	
0	·0185	·025	·0370	·099	·0556	·222	·0741	·395	·0926	·617	0
1	·0370	·074	·0556	·173	·0741	·321	·0926	·519	·1111	·765	1
2	·0556	·173	·0741	·296	·0926	·469	·1111	·691	·1296	·963	2
3	·0741	·321	·0926	·469	·1111	·667	·1296	·914	·1481	1·210	3
4	·0926	·519	·1111	·691	·1296	·914	·1481	1·185	·1667	1·506	4
5	·1111	·765	·1296	·963	·1481	1·210	·1667	1·506	·1852	1·852	5
6	·1296	1·062	·1481	1·284	·1667	1·556	·1852	1·877	·2037	2·247	6
7	·1481	1·407	·1667	1·654	·1852	1·951	·2037	2·296	·2222	2·691	7
8	·1667	1·802	·1852	2·074	·2037	2·395	·2222	2·765	·2407	3·185	8
9	·1852	2·247	·2037	2·543	·2222	2·889	·2407	3·284	·2593	3·728	9
10	·2037	2·741	·2222	3·062	·2407	3·432	·2593	3·852	2778	4·321	10
11	·2222	3·284	·2407	3·630	·2593	4·025	·2778	4·469	·2963	4·963	11
12	·2407	3·887	·2593	4·247	·2778	4·667	·2963	5·136	·3148	5·654	12
13	·2593	4·519	·2778	4·914	·2963	5·358	·3148	5·852	·3333	6·395	13
14	·2778	5·210	·2963	5·630	·3148	6·099	·3333	6·617	·3519	7·185	14
15	·2963	5·951	·3148	6·395	·3333	6·889	·3519	7·432	·3704	8·025	15
16	·3148	6·741	·3333	7·210	·3519	7·728	·3704	8·296	·3889	8·914	16
17	·3333	7·580	·3519	8·074	·3704	8·617	·3889	9·210	·4074	9·852	17
18	·3519	8·469	·3704	8·988	·3889	9·556	·4074	10·173	·4259	10·840	18
19	·3704	9·407	·3889	9·951	·4074	10·543	·4259	11·185	·4444	11·877	19
20	·3889	10·395	·4074	10·963	·4259	11·580	·4444	12·247	·4630	12·963	20
21	·4074	11·432	·4259	12·025	·4444	12·667	·4630	13·358	·4815	14·099	21
22	·4259	12·519	·4444	13·136	·4630	13·802	·4815	14·519	·5000	15·284	22
23	·4444	13·654	·4630	14·296	·4815	14·988	·5000	15·728	·5185	16·519	23
24	·4630	14·840	·4815	15·506	·5000	16·222	·5185	16·988	·5370	17·802	24
25	·4815	16·074	·5000	16·765	·5185	17·506	·5370	18·296	·5556	19·136	25
26	·5000	17·358	·5185	18·074	·5370	18·840	·5556	19·654	·5741	20·519	26
27	·5185	18·691	·5370	19·432	·5556	20·222	·5741	21·062	·5926	21·951	27
28	·5370	20·074	·5556	20·840	·5741	21·654	·5926	22·519	·6111	23·432	28
29	·5556	21·506	·5741	22·296	·5926	23·136	·6111	24·025	·6296	24·963	29
30	·5741	22·988	·5926	23·802	·6111	24·667	·6296	25·580	·6481	26·543	30
31	·5926	24·519	·6111	25·358	·6296	26·247	·6481	27·185	·6667	28·173	31
32	·6111	26·099	·6296	26·963	·6481	27·877	·6667	28·840	·6852	29·852	32
33	·6296	27·728	·6481	28·617	·6667	29·556	·6852	30·543	·7037	31·580	33
34	·6481	29·407	·6667	30·321	·6852	31·284	·7037	32·296	·7222	33·358	34
35	·6667	31·136	·6852	32·074	·7037	33·062	·7222	34·099	·7407	35·185	35
36	·6852	32·914	·7037	33·877	·7222	34·889	·7407	35·951	·7593	37·062	36
37	·7037	34·741	·7222	35·728	·7407	36·765	·7593	37·852	·7778	38·988	37
38	·7222	36·617	·7407	37·630	·7593	38·691	·7778	39·802	·7963	40·963	38
39	·7407	38·543	·7593	39·580	·7778	40·667	·7963	41·802	·8148	42·988	39
40	·7593	40·519	·7778	41·580	·7963	42·691	·8148	43·852	·8333	45·062	40

TABLE XLII.—BASE 1.—SLOPES 2 to 1.

Feet.	6		7		8		9		10		Feet.
	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	
0	·1111	·889	·1296	1·210	·1481	1·580	·1667	2·000	·1852	2·469	0
1	·1296	1·062	·1481	1·407	·1667	1·802	·1852	2·247	·2037	2·741	1
2	·1481	1·284	·1667	1·654	·1852	2·074	·2037	2·543	·2222	3·062	2
3	·1667	1·556	·1852	1·951	·2037	2·395	·2222	2·889	·2407	3·432	3
4	·1852	1·877	·2037	2·296	·2222	2·765	·2407	3·284	·2593	3·852	4
5	·2037	2·247	·2222	2·691	·2407	3·185	·2593	3·728	·2778	4·321	5
6	·2222	2·667	·2407	3·136	·2593	3·654	·2778	4·222	·2963	4·840	6
7	·2407	3·136	·2593	3·630	·2778	4·173	·2963	4·765	·3148	5·407	7
8	·2593	3·654	·2778	4·173	·2963	4·741	·3148	5·358	·3333	6·025	8
9	·2778	4·222	·2963	4·765	·3148	5·358	·3333	6·000	·3519	6·691	9
10	·2963	4·840	·3148	5·407	·3333	6·025	·3519	6·691	·3704	7·407	10
11	·3148	5·506	·3333	6·099	·3519	6·741	·3704	7·432	·3889	8·173	11
12	·3333	6·222	·3519	6·840	·3704	7·506	·3889	8·222	·4074	8·988	12
13	·3519	6·988	·3704	7·630	·3889	8·321	·4074	9·062	·4259	9·852	13
14	·3704	7·802	·3889	8·469	·4074	9·185	·4259	9·951	·4444	10·765	14
15	·3889	8·667	·4074	9·358	·4259	10·099	·4444	10·889	·4630	11·728	15
16	·4074	9·580	·4259	10·296	·4444	11·062	·4630	11·877	·4815	12·741	16
17	·4259	10·543	·4444	11·284	·4630	12·074	·4815	12·914	·5000	13·802	17
18	·4444	11·556	·4630	12·321	·4815	13·136	·5000	14·000	·5185	14·914	18
19	·4630	12·617	·4815	13·407	·5000	14·247	·5185	15·136	·5370	16·074	19
20	·4815	13·728	·5000	14·543	·5185	15·407	·5370	16·321	·5556	17·284	20
21	·5000	14·889	·5185	15·728	·5370	16·617	·5556	17·556	·5741	18·543	21
22	·5185	16·099	·5370	16·963	·5556	17·877	·5741	18·840	·5926	19·852	22
23	·5370	17·358	·5556	18·247	·5741	19·185	·5926	20·173	·6111	21·210	23
24	·5556	18·667	·5741	19·580	·5926	20·543	·6111	21·556	·6296	22·617	24
25	·5741	20·025	·5926	20·963	·6111	21·951	·6296	22·988	·6481	24·074	25
26	·5926	21·432	·6111	22·395	·6296	23·407	·6481	24·469	·6667	25·580	26
27	·6111	22·889	·6296	23·877	·6481	24·914	·6667	26·000	·6852	27·136	27
28	·6296	24·395	·6481	25·407	·6667	26·469	·6852	27·580	·7037	28·741	28
29	·6481	25·951	·6667	26·988	·6852	28·074	·7037	29·210	·7222	30·395	29
30	·6667	27·556	·6852	28·617	·7037	29·728	·7222	30·889	·7407	32·099	30
31	·6852	29·210	·7037	30·296	·7222	31·432	·7407	32·617	·7593	33·852	31
32	·7037	30·914	·7222	32·025	·7407	33·185	·7593	34·395	·7778	35·654	32
33	·7222	32·667	·7407	33·802	·7593	34·988	·7778	36·222	·7963	37·506	33
34	·7407	34·469	·7593	35·630	·7778	36·840	·7963	38·099	·8148	39·407	34
35	·7593	36·321	·7778	37·506	·7963	38·741	·8148	40·025	·8333	41·358	35
36	·7778	38·222	·7963	39·432	·8148	40·691	·8333	42·000	·8519	43·358	36
37	·7963	40·173	·8148	41·407	·8333	42·691	·8519	44·025	·8704	45·407	37
38	·8148	42·173	·8333	43·432	·8519	44·741	·8704	46·099	·8889	47·506	38
39	·8333	44·222	·8519	45·506	·8704	46·840	·8889	48·222	·9074	49·654	39
40	·8519	46·321	·8704	47·630	·8889	48·988	·9074	50·395	·9259	51·852	40

TABLE XLIII.—BASE 1.—SLOPES 2 to 1.

Feet.	11		12		13		14		15		Feet.
	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	
0	·2037	2·988	·2222	3·556	·2407	4·173	·2593	4·840	·2778	5·556	0
1	·2222	3·284	·2407	3·877	·2593	4·519	·2778	5·210	·2963	5·951	1
2	·2407	3·630	·2593	4·247	·2778	4·914	·2963	5·630	·3148	6·395	2
3	·2593	4·025	·2778	4·667	·2963	5·358	·3148	6·099	·3333	6·889	3
4	·2778	4·469	·2963	5·136	·3148	5·852	·3333	6·617	·3519	7·432	4
5	·2963	4·963	·3148	5·654	·3333	6·395	·3519	7·185	·3704	8·025	5
6	·3148	5·506	·3333	6·222	·3519	6·988	·3704	7·802	·3889	8·667	6
7	·3333	6·099	·3519	6·840	·3704	7·630	·3889	8·469	·4074	9·358	7
8	·3519	6·741	·3704	7·506	·3889	8·321	·4074	9·185	·4259	10·099	8
9	·3704	7·432	·3889	8·222	·4074	9·062	·4259	9·951	·4444	10·889	9
10	·3889	8·173	·4074	8·988	·4259	9·852	·4444	10·765	·4630	11·728	10
11	·4074	8·963	·4259	9·802	·4444	10·691	·4630	11·630	·4815	12·617	11
12	·4259	9·802	·4444	10·667	·4630	11·580	·4815	12·543	·5000	13·556	12
13	·4444	10·691	·4630	11·580	·4815	12·519	·5000	13·506	·5185	14·543	13
14	·4630	11·630	·4815	12·543	·5000	13·506	·5185	14·519	·5370	15·580	14
15	·4815	12·617	·5000	13·556	·5185	14·543	·5370	15·580	·5556	16·667	15
16	·5000	13·654	·5185	14·617	·5370	15·630	·5556	16·691	·5741	17·802	16
17	·5185	14·741	·5370	15·728	·5556	16·765	·5741	17·852	·5926	18·988	17
18	·5370	15·877	·5556	16·889	·5741	17·951	·5926	19·062	·6111	20·222	18
19	·5556	17·062	·5741	18·099	·5926	19·185	·6111	20·321	·6296	21·506	19
20	·5741	18·296	·5926	19·358	·6111	20·469	·6296	21·630	·6481	22·840	20
21	·5926	19·580	·6111	20·667	·6296	21·802	·6481	22·988	·6667	24·222	21
22	·6111	20·914	·6296	22·025	·6481	23·185	·6667	24·395	·6852	25·654	22
23	·6296	22·296	·6481	23·432	·6667	24·617	·6852	25·852	·7037	27·136	23
24	·6481	23·728	·6667	24·889	·6852	26·099	·7037	27·358	·7222	28·667	24
25	·6667	25·210	·6852	26·395	·7037	27·630	·7222	28·914	·7407	30·247	25
26	·6852	26·741	·7037	27·951	·7222	29·210	·7407	30·519	·7593	31·877	26
27	·7037	28·321	·7222	29·556	·7407	30·840	·7593	32·173	·7778	33·556	27
28	·7222	29·951	·7407	31·210	·7593	32·519	·7778	33·877	·7963	35·284	28
29	·7407	31·630	·7593	32·914	·7778	34·247	·7963	35·630	·8148	37·062	29
30	·7593	33·358	·7778	34·667	·7963	36·025	·8148	37·432	·8333	38·889	30
31	·7778	35·136	·7963	36·469	·8148	37·852	·8333	39·284	·8519	40·765	31
32	·7963	36·963	·8148	38·321	·8333	39·728	·8519	41·185	·8704	42·691	32
33	·8148	38·840	·8333	40·222	·8519	41·654	·8704	43·136	·8889	44·667	33
34	·8333	40·765	·8519	42·173	·8704	43·630	·8889	45·136	·9074	46·691	34
35	·8519	42·741	·8704	44·173	·8889	45·654	·9074	47·185	·9259	48·765	35
36	·8704	44·765	·8889	46·222	·9074	47·728	·9259	49·284	·9444	50·889	36
37	·8889	46·840	·9074	48·321	·9259	49·852	·9444	51·432	·9630	53·062	37
38	·9074	48·963	·9259	50·469	·9444	52·025	·9630	53·630	·9815	55·284	38
39	·9259	51·136	·9444	52·667	·9630	54·247	·9815	55·877	1·0000	57·556	39
40	·9444	53·358	·9630	54·914	·9815	56·519	1·0000	58·173	1·0185	59·877	40

TABLE XLIV.—BASE 1.—SLOPES 2 to 1.

Feet.	16		17		18		19		20		Feet.
	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	
0	·2963	6·321	·3148	7·136	·3333	8·000	·3519	8·914	·3704	9·877	0
1	·3148	6·741	·3333	7·580	·3519	8·469	·3704	9·407	·3889	10·395	1
2	·3333	7·210	·3519	8·074	·3704	8·988	·3889	9·951	·4074	10·963	2
3	·3519	7·728	·3704	8·617	·3889	9·556	·4074	10·543	·4259	11·580	3
4	·3704	8·296	·3889	9·210	·4074	10·173	·4259	11·185	·4444	12·247	4
5	·3889	8·914	·4074	9·852	·4259	10·840	·4444	11·877	·4630	12·963	5
6	·4074	9·580	·4259	10·543	·4444	11·556	·4630	12·617	·4815	13·728	6
7	·4259	10·296	·4444	11·284	·4630	12·321	·4815	13·407	·5000	14·543	7
8	·4444	11·062	·4630	12·074	·4815	13·136	·5000	14·247	·5185	15·407	8
9	·4630	11·877	·4815	12·914	·5000	14·000	·5185	15·136	·5370	16·321	9
10	·4815	12·741	·5000	13·802	·5185	14·914	·5370	16·074	·5556	17·284	10
11	·5000	13·654	·5185	14·741	·5370	15·877	·5556	17·062	·5741	18·296	11
12	·5185	14·617	·5370	15·728	·5556	16·889	·5741	18·099	·5926	19·358	12
13	·5370	15·630	·5556	16·765	·5741	17·951	·5926	19·185	·6111	20·469	13
14	·5556	16·691	·5741	17·852	·5926	19·062	·6111	20·321	·6296	21·630	14
15	·5741	17·802	·5926	18·988	·6111	20·222	·6296	21·506	·6481	22·840	15
16	·5926	18·963	·6111	20·173	·6296	21·432	·6481	22·741	·6667	24·099	16
17	·6111	20·173	·6296	21·407	·6481	22·691	·6667	24·025	·6852	25·407	17
18	·6296	21·432	·6481	22·691	·6667	24·000	·6852	25·358	·7037	26·765	18
19	·6481	22·741	·6667	24·025	·6852	25·358	·7037	26·741	·7222	28·173	19
20	·6667	24·099	·6852	25·407	·7037	26·765	·7222	28·173	·7407	29·630	20
21	·6852	25·506	·7037	26·840	·7222	28·222	·7407	29·654	·7593	31·136	21
22	·7037	26·963	·7222	28·321	·7407	29·728	·7593	31·185	·7778	32·691	22
23	·7222	28·469	·7407	29·852	·7593	31·284	·7778	32·765	·7963	34·296	23
24	·7407	30·025	·7593	31·432	·7778	32·889	·7963	34·395	·8148	35·951	24
25	·7593	31·630	·7778	33·062	·7963	34·543	·8148	36·074	·8333	37·654	25
26	·7778	33·284	·7963	34·741	·8148	36·247	·8333	37·802	·8519	39·407	26
27	·7963	34·988	·8148	36·469	·8333	38·000	·8519	39·580	·8704	41·210	27
28	·8148	36·741	·8333	38·247	·8519	39·802	·8704	41·407	·8889	43·062	28
29	·8333	38·543	·8519	40·074	·8704	41·654	·8889	43·284	·9074	44·963	29
30	·8519	40·395	·8704	41·951	·8889	43·556	·9074	45·210	·9259	46·914	30
31	·8704	42·296	·8889	43·877	·9074	45·506	·9259	47·185	·9444	48·914	31
32	·8889	44·247	·9074	45·852	·9259	47·506	·9444	49·210	·9630	50·963	32
33	·9074	46·247	·9259	47·877	·9444	49·556	·9630	51·284	·9815	53·062	33
34	·9259	48·296	·9444	49·951	·9630	51·654	·9815	53·407	1·0000	55·210	34
35	·9444	50·395	·9630	52·074	·9815	53·802	1·0000	55·580	1·0185	57·407	35
36	·9630	52·543	·9815	54·247	1·0000	56·000	1·0185	57·802	1·0370	59·654	36
37	·9815	54·741	1·0000	56·469	1·0185	58·247	1·0370	60·074	1·0556	61·951	37
38	1·0000	56·988	1·0185	58·741	1·0370	60·543	1·0556	62·395	1·0741	64·296	38
39	1·0185	59·284	1·0370	61·062	1·0556	62·889	1·0741	64·675	1·0926	66·691	39
40	1·0370	61·630	1·0556	63·432	1·0741	65·284	1·0926	67·185	1·1111	69·136	40

TABLE XLV.—BASE 1.—SLOPES 2 to 1.

Feet.	21		22		23		24		25		Feet.
	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	
0	·3889	10·889	·4074	11·951	·4259	13·062	·4444	14·222	·4630	15·432	0
1	·4074	11·432	·4259	12·519	·4444	13·654	·4630	14·840	·4815	16·074	1
2	·4259	12·025	·4444	13·136	·4630	14·296	·4815	15·506	·5000	16·765	2
3	·4444	12·667	·4630	13·802	·4815	14·988	·5000	16·222	·5185	17·506	3
4	·4630	13·358	·4815	14·519	·5000	15·728	·5185	16·988	·5370	18·296	4
5	·4815	14·099	·5000	15·284	·5185	16·519	·5370	17·802	·5556	19·136	5
6	·5000	14·889	·5185	16·099	·5370	17·358	·5556	18·667	·5741	20·025	6
7	·5185	15·728	·5370	16·963	·5556	18·247	·5741	19·580	·5926	20·963	7
8	·5370	16·617	·5556	17·877	·5741	19·185	·5926	20·543	·6111	21·951	8
9	·5556	17·556	·5741	18·840	·5926	20·173	·6111	21·556	·6296	22·988	9
10	·5741	18·543	·5926	19·852	·6111	21·210	·6296	22·617	·6481	24·074	10
11	·5926	19·580	·6111	20·914	·6296	22·296	·6481	23·728	·6667	25·210	11
12	·6111	20·667	·6296	22·025	·6481	23·432	·6667	24·889	·6852	26·395	12
13	·6296	21·802	·6481	23·185	·6667	24·617	·6852	26·099	·7037	27·630	13
14	·6481	22·988	·6667	24·395	·6852	25·852	·7037	27·358	·7222	28·914	14
15	·6667	24·222	·6852	25·654	·7037	27·136	·7222	28·667	·7407	30·247	15
16	·6852	25·506	·7037	26·963	·7222	28·469	·7407	30·025	·7593	31·630	16
17	·7037	26·840	·7222	28·321	·7407	29·852	·7593	31·432	·7778	33·062	17
18	·7222	28·222	·7407	29·728	·7593	31·284	·7778	32·889	·7963	34·543	18
19	·7407	29·654	·7593	31·185	·7778	32·765	·7963	34·395	·8148	36·074	19
20	·7593	31·136	·7778	32·691	·7963	34·296	·8148	35·951	·8333	37·654	20
21	·7778	32·667	·7963	34·247	·8148	35·877	·8333	37·556	·8519	39·284	21
22	·7963	34·247	·8148	35·852	·8333	37·506	·8519	39·210	·8704	40·963	22
23	·8148	35·877	·8333	37·506	·8519	39·185	·8704	40·914	·8889	42·691	23
24	·8333	37·556	·8519	39·210	·8704	40·914	·8889	42·667	·9074	44·469	24
25	·8519	39·284	·8704	40·963	·8889	42·691	·9074	44·469	·9259	46·296	25
26	·8704	41·062	·8889	42·765	·9074	44·519	·9259	46·321	·9444	48·173	26
27	·8889	42·889	·9074	44·617	·9259	46·395	·9444	48·222	·9630	50·099	27
28	·9074	44·765	·9259	46·519	·9444	48·321	·9630	50·173	·9815	52·074	28
29	·9259	46·691	·9444	48·469	·9630	50·296	·9815	52·173	1·0000	54·099	29
30	·9444	48·667	·9630	50·469	·9815	52·321	1·0000	54·222	1·0185	56·173	30
31	·9630	50·691	·9815	52·519	1·0000	54·395	1·0185	56·321	1·0370	58·296	31
32	·9815	52·765	1·0000	54·617	1·0185	56·519	1·0370	58·469	1·0556	60·469	32
33	1·0000	54·889	1·0185	56·765	1·0370	58·691	1·0556	60·667	1·0741	62·691	33
34	1·0185	57·062	1·0370	58·963	1·0556	60·914	1·0741	62·914	1·0926	64·963	34
35	1·0370	59·284	1·0556	61·210	1·0741	63·185	1·0926	65·210	1·1111	67·284	35
36	1·0556	61·556	1·0741	63·506	1·0926	65·506	1·1111	67·556	1·1296	69·654	36
37	1·0741	63·877	1·0926	65·852	1·1111	67·877	1·1296	69·951	1·1481	72·074	37
38	1·0926	66·247	1·1111	68·247	1·1296	70·296	1·1481	72·395	1·1667	74·543	38
39	1·1111	68·667	1·1296	70·691	1·1481	72·765	1·1667	74·889	1·1852	77·062	39
40	1·1296	71·136	1·1481	73·185	1·1667	75·284	1·1852	77·432	1·2047	79·630	40

TABLE XLVI.—BASE 1.—SLOPES 2 to 1.

Feet.	26		27		28		29		30		Feet.
	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	
0	·4815	16·691	·5000	18·000	·5185	19·358	·5370	20·765	·5556	22·222	0
1	·5000	17·358	·5185	18·691	·5370	20·074	·5556	21·506	·5741	22·988	1
2	·5185	18·074	·5370	19·432	·5556	20·840	·5741	22·296	·5926	23·802	2
3	·5370	18·840	·5556	20·222	·5741	21·654	·5926	23·136	·6111	24·667	3
4	·5556	19·654	·5741	21·062	·5926	22·519	·6111	24·025	·6296	25·580	4
5	·5741	20·519	·5926	21·951	·6111	23·432	·6296	24·963	·6481	26·543	5
6	·5926	21·432	·6111	22·889	·6296	24·395	·6481	25·951	·6667	27·556	6
7	·6111	22·395	·6296	23·877	·6481	25·407	·6667	26·988	·6852	28·617	7
8	·6296	23·407	·6481	24·914	·6667	26·469	·6852	28·074	·7037	29·728	8
9	·6481	24·469	·6667	26·000	·6852	27·580	·7037	29·210	·7222	30·889	9
10	·6667	25·580	·6852	27·136	·7037	28·741	·7222	30·395	·7407	32·099	10
11	·6852	26·741	·7037	28·321	·7222	29·951	·7407	31·630	·7593	33·358	11
12	·7037	27·951	·7222	29·556	·7407	31·210	·7593	32·914	·7778	34·667	12
13	·7222	29·210	·7407	30·840	·7593	32·519	·7778	34·247	·7963	36·025	13
14	·7407	30·519	·7593	32·173	·7778	33·877	·7963	35·630	·8148	37·432	14
15	·7593	31·877	·7778	33·556	·7963	35·284	·8148	37·062	·8333	38·889	15
16	·7778	33·284	·7963	34·988	·8148	36·741	·8333	38·543	·8519	40·395	16
17	·7963	34·741	·8148	36·469	·8333	38·247	·8519	40·074	·8704	41·951	17
18	·8148	36·247	·8333	38·000	·8519	39·802	·8704	41·654	·8889	43·556	18
19	·8333	37·802	·8519	39·580	·8704	41·407	·8889	43·284	·9074	45·210	19
20	·8519	39·407	·8704	41·210	·8889	43·062	·9074	44·963	·9259	46·914	20
21	·8704	41·062	·8889	42·889	·9074	44·765	·9259	46·691	·9444	48·667	21
22	·8889	42·765	·9074	44·617	·9259	46·519	·9444	48·469	·9630	50·469	22
23	·9074	44·519	·9259	46·395	·9444	48·321	·9630	50·296	·9815	52·321	23
24	·9259	46·321	·9444	48·222	·9630	50·173	·9815	52·173	1·0000	54·222	24
25	·9444	48·173	·9630	50·099	·9815	52·074	1·0000	54·099	1·0185	56·173	25
26	·9630	50·074	·9815	52·025	1·0000	54·025	1·0185	56·074	1·0370	58·173	26
27	·9815	52·025	1·0000	54·000	1·0185	56·025	1·0370	58·099	1·0556	60·222	27
28	1·0000	54·025	1·0185	56·025	1·0370	58·074	1·0556	60·173	1·0741	62·321	28
29	1·0185	56·074	1·0370	58·099	1·0556	60·173	1·0741	62·296	1·0926	64·469	29
30	1·0370	58·173	1·0556	60·222	1·0741	62·321	1·0926	64·469	1·1111	66·667	30
31	1·0556	60·321	1·0741	62·395	1·0926	64·519	1·1111	66·691	1·1296	68·914	31
32	1·0741	62·519	1·0926	64·617	1·1111	66·765	1·1296	68·963	1·1481	71·210	32
33	1·0926	64·765	1·1111	66·889	1·1296	69·062	1·1481	71·284	1·1667	73·556	33
34	1·1111	67·062	1·1296	69·210	1·1481	71·407	1·1667	73·654	1·1852	75·951	34
35	1·1296	69·407	1·1481	71·580	1·1667	73·802	1·1852	76·074	1·2047	78·395	35
36	1·1481	71·802	1·1667	74·000	1·1852	76·247	1·2047	78·543	1·2222	80·889	36
37	1·1667	74·247	1·1852	76·469	1·2047	78·741	1·2222	81·062	1·2407	83·432	37
38	1·1852	76·741	1·2047	78·988	1·2222	81·284	1·2407	83·630	1·2593	86·025	38
39	1·2047	79·284	1·2222	81·556	1·2407	83·877	1·2593	86·247	1·2778	88·667	39
40	1·2222	81·877	1·2407	84·173	1·2593	86·519	1·2778	88·914	1·2963	91·358	40

TABLE XLVII.—BASE 1.—SLOPES 2 to 1.

Feet.	31		32		33		34		35		Feet.
	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	
0	·5741	23·728	·5926	25·284	·6111	26·889	·6296	28·543	·6481	30·247	0
1	·5926	24·519	·6111	26·099	·6296	27·728	·6481	29·407	·6667	31·136	1
2	·6111	25·358	·6296	26·963	·6481	28·617	·6667	30·321	·6852	32·074	2
3	·6296	26·247	·6481	27·877	·6667	29·556	·6852	31·284	·7037	33·062	3
4	·6481	27·185	·6667	28·840	·6852	30·543	·7037	32·296	·7222	34·099	4
5	·6667	28·273	·6852	29·852	·7037	31·580	·7222	33·358	·7407	35·185	5
6	·6852	29·210	·7037	30·914	·7222	32·667	·7407	34·469	·7593	36·321	6
7	·7037	30·296	·7222	32·025	·7407	33·802	·7593	35·630	·7778	37·506	7
8	·7222	31·432	·7407	33·185	·7593	34·988	·7778	36·840	·7963	38·741	8
9	·7407	32·617	·7593	34·395	·7778	36·222	·7963	38·099	·8148	40·025	9
10	·7593	33·852	·7778	35·654	·7963	37·506	·8148	39·407	·8333	41·358	10
11	·7778	35·136	·7963	36·963	·8148	38·840	·8333	40·765	·8519	42·741	11
12	·7963	36·469	·8148	38·321	·8333	40·222	·8519	42·173	·8704	44·173	12
13	·8148	37·852	·8333	39·728	·8519	41·654	·8704	43·630	·8889	45·654	13
14	·8333	39·284	·8519	41·185	·8704	43·136	·8889	45·136	·9074	47·185	14
15	·8519	40·765	·8704	42·691	·8889	44·667	·9074	46·691	·9259	48·765	15
16	·8704	42·296	·8889	44·247	·9074	46·247	·9259	48·296	·9444	50·395	16
17	·8889	43·877	·9074	45·852	·9259	47·877	·9444	49·951	·9630	52·074	17
18	·9074	45·506	·9259	47·506	·9444	49·556	·9630	51·654	·9815	53·802	18
19	·9259	47·185	·9444	49·210	·9630	51·284	·9815	53·407	1·0000	55·580	19
20	·9444	48·914	·9630	50·963	·9815	53·062	1·0000	55·210	1·0185	57·407	20
21	·9630	50·691	·9815	52·765	1·0000	54·889	1·0185	57·062	1·0370	59·284	21
22	·9815	52·519	1·0000	54·617	1·0185	56·765	1·0370	58·963	1·0556	61·210	22
23	1·0000	54·395	1·0185	56·519	1·0370	58·691	1·0556	60·914	1·0741	63·185	23
24	1·0185	56·321	1·0370	58·469	1·0556	60·667	1·0741	62·914	1·0926	65·210	24
25	1·0370	58·296	1·0556	60·469	1·0741	62·691	1·0926	64·963	1·1111	67·284	25
26	1·0556	60·321	1·0741	62·519	1·0926	64·765	1·1111	67·062	1·1296	69·407	26
27	1·0741	62·395	1·0926	64·617	1·1111	66·889	1·1296	69·210	1·1481	71·580	27
28	1·0926	64·519	1·1111	66·765	1·1296	69·062	1·1481	71·407	1·1667	73·802	28
29	1·1111	66·691	1·1296	68·963	1·1481	71·284	1·1667	73·654	1·1852	76·074	29
30	1·1296	68·914	1·1481	71·210	1·1667	73·556	1·1852	75·951	1·2047	78·395	30
31	1·1481	71·185	1·1667	73·506	1·1852	75·877	1·2047	78·296	1·2222	80·765	31
32	1·1667	73·506	1·1852	75·852	1·2047	78·247	1·2222	80·691	1·2407	83·185	32
33	1·1852	75·877	1·2047	78·247	1·2222	80·667	1·2407	83·136	1·2593	85·654	33
34	1·2047	78·296	1·2222	80·691	1·2407	83·136	1·2593	85·630	1·2778	88·173	34
35	1·2222	80·765	1·2407	83·185	1·2593	85·654	1·2778	88·173	1·2963	90·741	35
36	1·2407	83·284	1·2593	85·728	1·2778	88·222	1·2963	90·765	1·3148	93·358	36
37	1·2593	85·852	1·2778	88·321	1·2963	90·840	1·3148	93·407	1·3333	96·025	37
38	1·2778	88·469	1·2963	90·963	1·3148	93·506	1·3333	96·099	1·3519	98·741	38
39	1·2963	91·136	1·3148	93·654	1·3333	96·222	1·3519	98·840	1·3704	101·506	39
40	1·3148	93·852	1·3333	96·395	1·3519	98·988	1·3704	101·630	1·3889	104·321	40

TABLE XLVIII.—BASE 1.—SLOPES 2 to 1.

Feet.	36		37		38		39		40		Feet.
	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	Mult.	Add.	
0	·6667	32·000	·6852	33·802	·7037	35·654	·7222	37·556	·7407	39·506	0
1	·6852	32·914	·7037	34·741	·7222	36·617	·7407	38·543	·7593	40·519	1
2	·7037	33·877	·7222	35·728	·7407	37·630	·7593	39·580	·7778	41·580	2
3	·7222	34·889	·7407	36·765	·7593	38·691	·7778	40·667	·7963	42·691	3
4	·7407	35·951	·7593	37·852	·7778	39·802	·7963	41·802	·8148	43·852	4
5	·7593	37·062	·7778	38·988	·7963	40·963	·8148	42·988	·8333	45·062	5
6	·7778	38·222	·7963	40·173	·8148	42·173	·8333	44·222	·8519	46·321	6
7	·7963	39·432	·8148	41·407	·8333	42·432	·8519	45·506	·8704	47·630	7
8	·8148	40·691	·8333	42·691	·8519	44·741	·8704	46·840	·8889	48·988	8
9	·8333	42·000	·8519	44·025	·8704	46·099	·8889	48·222	·9074	50·395	9
10	·8519	43·358	·8704	45·407	·8889	47·506	·9074	49·654	·9259	51·852	10
11	·8704	44·765	·8889	46·840	·9074	48·963	·9259	51·136	·9444	53·358	11
12	·8889	46·222	·9074	48·321	·9259	50·469	·9444	52·667	·9630	54·914	12
13	·9074	47·728	·9259	49·852	·9444	52·025	·9630	54·247	·9815	56·519	13
14	·9259	49·284	·9444	51·432	·9630	53·630	·9815	55·877	1·0000	58·173	14
15	·9444	50·889	·9630	53·062	·9815	55·284	1·0000	57·556	1·0185	59·877	15
16	·9630	52·543	·9815	54·741	1·0000	56·988	1·0185	59·284	1·0370	61·630	16
17	·9815	54·247	1·0000	56·469	1·0185	58·741	1·0370	61·062	1·0556	63·432	17
18	1·0000	56·000	1·0185	58·247	1·0370	60·543	1·0556	62·889	1·0741	65·284	18
19	1·0185	57·802	1·0370	60·074	1·0556	62·395	1·0741	64·765	1·0926	67·185	19
20	1·0370	59·654	1·0556	61·951	1·0741	64·296	1·0926	66·691	1·1111	69·136	20
21	1·0556	61·556	1·0741	63·877	1·0926	66·247	1·1111	68·667	1·1296	71·136	21
22	1·0741	63·506	1·0926	65·852	1·1111	68·247	1·1296	70·691	1·1481	73·185	22
23	1·0926	65·506	1·1111	67·877	1·1296	70·296	1·1481	72·765	1·1667	75·284	23
24	1·1111	67·556	1·1296	69·951	1·1481	72·395	1·1667	74·889	1·1852	77·432	24
25	1·1296	69·654	1·1481	72·074	1·1667	74·543	1·1852	77·062	1·2047	79·630	25
26	1·1481	71·802	1·1667	74·247	1·1852	76·741	1·2047	79·284	1·2222	81·877	26
27	1·1667	74·000	1·1852	76·469	1·2047	78·988	1·2222	81·556	1·2407	84·173	27
28	1·1852	76·247	1·2047	78·741	1·2222	81·284	1·2407	83·877	1·2593	86·519	28
29	1·2047	78·543	1·2222	81·062	1·2407	83·630	1·2593	86·247	1·2778	88·914	29
30	1·2222	80·889	1·2407	83·432	1·2593	86·025	1·2778	88·667	1·2963	91·358	30
31	1·2407	83·284	1·2593	85·852	1·2778	88·469	1·2963	91·136	1·3148	93·852	31
32	1·2593	85·728	1·2778	88·321	1·2963	90·963	1·3148	93·654	1·3333	96·395	32
33	1·2778	88·222	1·2963	90·840	1·3148	93·506	1·3333	96·222	1·3519	98·988	33
34	1·2963	90·765	1·3148	93·407	1·3333	96·099	1·3519	98·840	1·3704	101·630	34
35	1·3148	93·358	1·3333	96·025	1·3519	98·741	1·3704	101·506	1·3889	104·321	35
36	1·3333	96·000	1·3519	98·691	1·3704	101·432	1·3889	104·222	1·4074	107·062	36
37	1·3519	98·691	1·3704	101·407	1·3889	104·173	1·4074	106·988	1·4259	109·852	37
38	1·3704	101·432	1·3889	104·173	1·4074	106·963	1·4259	109·802	1·4444	112·691	38
39	1·3889	104·222	1·4074	106·988	1·4259	109·802	1·4444	112·667	1·4630	115·580	39
40	1·4074	107·062	1·4259	109·852	1·4444	112·691	1·4630	115·580	1·4815	118·519	40

TABLE XLIX.

For calculating the Area of the Arch Ring and Segment of Intrados of any Arch of the undermentioned rise and thickness.

Thickness of Arch Ring.	RISE = ⅛ SPAN.			RISE = ¼ SPAN.			RISE = ⅕ SPAN.			RISE = ⅙ SPAN.			RISE = ⅐ SPAN.			Thickness of Arch Ring.
	Area of Segment.	Area of Arch Ring.		Area of Segment.	Area of Arch Ring.		Area of Segment.	Area of Arch Ring.		Area of Segment.	Area of Arch Ring.		Area of Segment.	Area of Arch Ring.		
		Multiply.	Add.		Multiply.	Add.		Multiply.	Add.		Multiply.	Add.		Multiply.	Add.	
6″	·246878 × (Span)²	·6370	·2940	·174724 × (Span)²	·5795	·2318	·137505 × (Span)²	·5517	·1902	·113543 × (Span)²	·5362	·1608	·096778 × (Span)²	·5267	·1391	6″
9″		·9555	·6615		·8693	·5216		·8276	·4280		·8043	·3619		·7901	·3131	9″
12″		1·2740	1·1760		1·1591	·9273		1·1034	·7610		1·0725	·6435		1·0535	·5566	12″
15″		1·5925	1·8375		1·4489	1·4489		1·3793	1·1890		1·3406	1·0054		1·3169	·8697	15″
18″		1·9110	2·6460		1·7387	2·0864		1·6552	1·7122		1·6087	1·4478		1·5803	1·2523	18″
21″		2·2295	3·6015		2·0285	2·8398		1·9310	2·3306		1·8769	1·9707		1·8437	1·7046	21″
24″		2·5480	4·7040		2·3182	3·7092		2·2069	3·0440		2·1450	2·5740		2·1071	2·2264	24″
27″		2·8665	5·9535		2·6080	4·6044		2·4828	3·8526		2·4131	3·2577		2·3705	2·8178	27″
30″		3·1850	7·3500		2·8978	5·7956		2·7586	4·7563		2·6812	4·0219		2·6339	3·4787	30″
33″		3·5035	8·8936		3·1876	7·0127		3·0345	5·7551		2·9493	4·8665		2·8973	4·2093	33″
36″		3·8220	10·5840		3·4773	8·3456		3·3104	6·8491		3·2175	5·7915		3·1605	5·0094	36″
	Radius = ·5416 × Span.			Radius = ·625 × Span.			Radius = ·725 × Span.			Radius = ·83 × Span.			Radius = ·946428 × Span.			

EXAMPLE.

Given Span..... 30 feet
,, Rise ..... ⅕ Span
Thickness of Arch Ring 18″

Then Area of Arch Ring = (1·6552 × 30) + 1·7122 = 51·36 Square feet.
,, ,, Segment of Intrados = ·137505 × 30² = 123·75 ,,
,, Radius of Circle ..... = ·725 × 30 = 21·75 feet.

TABLE L.

AREAS OF ARCH RINGS, SEGMENTS, &c.

Span.	Area of Segment.	Rise = ½ Span. Thickness of Ring.							Area of Segment.	Rise = ⅓ Span. Thickness of Ring.						
		9″	12″	15″	18″	21″	24″	27″		9″	12″	15″	18″	21″	24″	27″
V	9·81	6·77	9·42	12·2	15·3	...	...	...	6·02	5·43	7·54	9·80	12·2	...	...	...
VI	14·1	7·95	10·9	14·2	17·6	...	...	...	8·67	6·39	8·82	11·3	14·1	...	...	...
VII	19·2	9·13	12·5	16·2	20·0	...	...	...	11·8	7·35	10·0	12·9	16·0	...	...	...
VIII	25·1	10·3	14·1	18·1	22·3	...	...	...	15·4	8·30	11·3	14·5	17·9	...	...	...
IX	31·8	11·4	15·7	20·1	24·7	...	...	...	19·5	9·26	12·6	16·1	19·8	...	...	...
X	39·2	12·6	17·2	22·0	27·0	32·2	...	...	24·0	10·2	13·9	17·7	21·7	25·8	...	...
XII	56·5	15·0	20·4	26·0	31·8	37·8	...	...	34·6	12·1	16·4	20·9	25·5	30·3	...	...
XV	88·3	18·5	25·1	31·9	38·8	46·0	...	...	54·1	14·9	20·2	25·7	31·3	37·0	...	...
XVIII	127	...	29·8	37·8	45·9	54·2	62·8	...	78·0	...	24·2	30·5	37·0	43·7	50·5	...
XX	157	...	32·9	41·7	50·6	59·7	69·1	...	96·3	...	26·6	33·6	40·8	48·1	55·6	...
XXV	245	...	40·8	51·5	62·4	73·5	84·8	...	150	...	33·0	41·6	50·4	59·3	68·4	...
XXX	353	...	...	61·3	74·2	87·2	100	113	216	...	...	49·6	59·9	70·4	81·1	91·9
XXXV	481	...	...	71·1	86·0	101	116	131	295	...	...	57·5	69·5	81·6	93·8	106
XL	628	...	...	80·9	97·7	114	131	149	385	...	...	65·5	79·0	92·7	106	120
XLV	795	...	...	90·8	10·9	128	147	166	487	...	...	73·5	88·6	103	119	134
	Radius of Circle = ·5 Span.								Radius of Circle = ·541 Span.							

Note.—All areas are given in square feet.

TABLE LI.

AREAS OF ARCH RINGS, SEGMENTS, &c.

Span.	Area of Segment.	Rise = ¼ Span. Thickness of Ring.							Area of Segment.	Rise = ⅓ Span. Thickness of Ring.						
		9″	12″	15″	18″	21″	24″	27″		9″	12″	15″	18″	21″	24″	27″
V	4·36	4·86	6·72	8·69	10·7	...	...	...	3·43	4·56	6·27	8·08	9·98	...	...	...
VI	6·29	5·73	7·88	10·1	12·5	...	...	...	4·95	5·39	7·38	9·46	11·6	...	...	...
VII	8·56	6·60	9·04	11·5	14·2	...	...	...	6·73	6·22	8·48	10·8	13·2	...	...	...
VIII	11·1	7·47	10·2	13·0	15·9	...	..	...	8·80	7·04	9·58	12·2	14·9	...	...	...
IX	14·1	8·34	11·3	14·4	17·7	...	...	...	11·1	7·87	10·6	13·6	16·6	...	...	...
X	17·4	9·21	12·5	15·9	19·4	23·1	...	...	13·7	8·70	11·7	14·9	18·2	21·6	...	...
XII	25·1	10·9	14·8	18·8	22·9	27·1	...	...	19·8	10·3	14·0	17·7	21·5	25·5	...	...
XV	39·3	13·5	18·3	23·1	28·1	33·2	...	...	30·9	12·8	17·3	21·8	26·5	31·2	...	...
XVIII	56·6	...	21·7	27·5	33·3	39·3	45·4	...	44·5	...	20·6	26·0	31·5	37·0	42·7	...
XX	69·8	...	24·1	30·4	36·8	43·4	50·0	...	55·0	...	22·8	28·7	34·8	40·9	47·1	...
XXV	109	...	29·9	37·6	45·5	53·5	61·6	...	85·9	..	28·3	35·6	43·0	50·6	58·2	...
XXX	157	...	...	44·9	54·2	63·6	73·2	82·9	123	...	...	42·5	51·3	60·2	69·2	78·3
XXXV	214	...	...	52·1	62·9	73·8	84·8	95·9	168	...	...	49·4	59·6	69·9	80·2	90·7
XL	279	...	...	59·4	71·6	83·9	96·4	109	220	...	...	56·3	67·9	79·5	91·3	103
XLV	353	...	...	66·6	80·3	94·1	108	122	278	...	...	63·2	76·1	89·2	102	115
		Radius of Circle = ·625 Span.								Radius of Circle = ·725 Span.						

Note.—All areas are given in square feet.

TABLE LII.

AREAS OF ARCH RINGS, SEGMENTS, &c.

Span.	Area of Segment.	Rise = ⅛ Span. Thickness of Ring.							Area of Segment.	Rise = ⅐ Span. Thickness of Ring.						
		9″	12″	15″	18″	21″	24″	27″		9″	12″	15″	18″	21″	24″	27″
V	2·83	4·38	6·00	7·70	9·49	...	...	...	2·41	4·26	5·82	7·45	9·15	...	...	...
VI	4·08	5·18	7·07	9·04	11·1	...	...	...	3·48	5·05	6·87	8·77	10·7	...	...	...
VII	5·56	5·99	8·15	10·3	12·7	...	...	...	4·74	5·84	7·93	10·0	12·3	...	...	...
VIII	7·26	6·79	9·22	11·7	14·3	...	...	...	6·19	6·63	8·98	11·4	13·8	...	...	...
IX	9·19	7·60	10·2	13·0	15·9	...	...	...	7·83	7·42	10·0	12·7	15·4	...	...	...
X	11·3	8·40	11·3	14·4	17·5	20·7	...	...	9·67	8·21	11·0	14·0	17·0	20·1	...	...
XII	16·3	10·0	13·5	17·0	20·7	24·4	...	...	13·9	9·79	13·1	16·6	20·2	23·8	...	...
XV	25·5	12·4	16·7	21·1	25·5	30·1	...	...	21·7	12·1	16·3	20·6	24·9	29·3	...	...
XVIII	36·7	...	19·9	25·1	30·4	35·7	41·1	...	31·3	...	19·5	24·5	29·6	34·8	40·1	...
XX	45·4	...	22·0	27·8	33·6	39·5	45·4	...	38·7	...	21·6	27·2	32·8	38·5	44·3	...
XXV	70·9	...	27·4	34·5	41·6	48·8	56·1	...	60·4	...	26·8	33·7	40·7	47·7	54·9	...
XXX	102	...	...	41·2	49·7	58·2	66·9	75·6	87·1	...	...	40·3	48·6	57·0	65·4	73·9
XXXV	139	...	...	47·9	57·7	67·6	77·6	87·7	118	...	...	46·9	56·5	66·2	75·9	85·7
XL	181	..	...	54·6	65·7	77·0	88·3	99·7	154	...	...	53·5	64·4	75·4	86·5	97·6
XLV	229	..	...	61·3	73·8	86·4	99·0	111	195	...	...	60·1	72·3	84·6	97·0	109
		Radius of Circle = ·83 Span.								Radius of Circle = ·946 Span.						

Note.—All areas are given in square feet.

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